North Coast LRMP

FINAL DRAFT

Socio-Economic and Environmental Assessment of Interim Scenarios developed by the North Coast LRMP Table as of April 2004

Volume II: Environmental Risk Assessment

Prepared for:
North Coast Land and Resource Management Plan Table and
BC Ministry of Sustainable Resource Management

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1. EXECUTIVE SUMMARY

Purpose

The primary purpose of this report is to summarize the environmental implications and relative risks of implementing the LRMP Scenario tentatively agreed to at the March 26-28, 2004 North Coast Land and Resource Management Plan (NC LRMP) Table meeting compared to a Baseline Scenario, which assumes current management practices are continued into the future. An environmental risk assessment (ERA) is the tool used to assess risk to selected environmental values. ERAs project risk (i.e., probability) of undesirable outcomes for key environmental values arising from implementation of the two land-use scenarios. Comparing the low risk or natural benchmark to the Baseline and LRMP Scenario is meant to assess how risk to each environmental value changes under different land use regimes.

Scenarios

Two scenarios were developed for this analysis, a LRMP Scenario and a Baseline Scenario.

As per MSRM's SEEA methodology a Base Case was analyzed, herein called the Baseline Scenario. For this project, it is the current set of management directions and rules, including the current amount of protection areas. *It is a baseline for analysis and represents neither a status quo option nor an Ecosystem-Based Management (EBM) alternative that is under consideration for future implementation by the BC Government.*

Under the LRMP Scenario agreed to in-principle at the March 26-28, 2004 NC LRMP Table meeting, approximately 35% of the NC plan area is proposed for protection. The percentage share of the plan area's gross land base in current or proposed protection areas for the Baseline and LRMP Scenario is shown in the following table.

Table ES1 – LRMP Scenario protection area

Indicator	Plan's GLB Area (ha)	Scenarios	
		Baseline	LRMP
		% Share in Current or Proposed Protection Areas	
Gross land base	1,695,532 ha	~ 3%	~ 35%

Risk Analysis Results

The following table presents the risk assessment category results for the studied environmental values for each scenario.

In this table, the cells are colour coded to indicate the risk category for each analyzed environmental value by each scenario, as per the following chart.

Environmental Risk Category	very low	low	moderate	high	very high
Colour code					

Environmental Value	Scenarios	
	Baseline	LRMP Scenario
Old-Growth Ecosystems	*High to very high risk*	*Moderate-high risk in short term*
	0% to 12% representation of any one ecosystem in protection areas	*Lower risk in long term and with application of 70% RONV representation*
BEC Variant	All BEC variants at *high risk* accept the AT (low risk) & CWHwm (moderate)	All BEC variants are at *moderate or low risk; hydroriparian & Fine Filter does not augment the area of any BEC variant in PAs.*
Ecosection	*High risk* for Hecate Lowlands, Meziadin Mts, & Southern Boundary, moderate risk for the Kitimat Ranges	*Low risk* for Hecate Lowlands, Southern Boundary and Kitimat Ranges
		High risk for Meziadin Mts
Grizzly Bear	*Low risk across plan area, although*	*Very low risk*
	moderate to high in some LUs	
Mountain Goat	*Low risk*	*Very low risk*
Marbled Murrelet	*Low-moderate risk*	*Low risk*
Black Bear	*Low risk*	*Very low risk*
Moose	*Low risk*	*Very low risk*
Northen Goshawk	*High risk*	*Low risk*
Tailed Frog	*High risk*	*Low-moderate risk*
Aquatic & Riparian Ecosystems	Salmon supporting ecosystems - *high risk*	Salmon supporting ecosystems – *moderate risk*
	Lakes – *moderate risk*	Lakes – *very low risk*
	Floodplains – *moderate risk*	Floodplains – *low risk*
Rare & Endangered Ecosystems	*High risk*	*Very low risk*

Longer summaries of environmental risks for each studied environmental value appear on the following pages of this executive summary.

Conclusions

The overarching conclusion for the environmental values, based on currently available information, is that the Baseline Scenario and LRMP Scenario generally form two risk groups. The table above clearly shows that the Baseline Scenario is a higher risk group and the LRMP Scenario is a lower risk group. Further, increasing the level of protection above the LRMP Scenario only modestly lowers environmental risk over the LRMP Scenario [Maxcy and Crane Management Consultants March 2004].

An important element of the CIT's Ecosystem-Based Management Handbook and the implementation of EBM in the NC LRMP is the balancing of ecological and economic integrity. As shown in the Socio-Economic Analysis report of this SEEA, the economic impacts of the LRMP Scenario are more favourable than Scenarios with higher levels of protection [Crane Management Consultants March 2004].

Implementation of the LRMP Scenario would directly help to maintain opportunities for traditional coastal industries like forestry and mining while also providing market certainty for BC wood products, and further supporting opportunities in tourism and other emerging markets and business sectors, including using EBM and environmental protection as a foundation for those other sectors to build on. Given current information, the LRMP Scenario provides an acceptable level of environmental risk and much less risk than the Baseline Scenario. The LRMP Scenario is more likely to result in a diversified, sustainable economy, providing greater investor certainty, and protecting important environmental values than either the Baseline Scenario, or other Scenarios previously investigated.

Value	Baseline Scenario	LRMP Scenario
Biodiversity Old-Growth Eco-systems	• The area of old forest ecosystems in protection areas is low for most ecosystems, regardless of risk level ranging from 0% to 12% protection. There is no representation of any old forest ecosystem in protection areas in the THLB under the Baseline Scenario. • When amount of old forest across the landbase through time is considered, the amount of old forest for many of the ecosystems decreases under the Baseline Scenario. The highest reductions are in high productivity units (which start low and become lower), and for medium productivity ecosystems in which old forest area declines by as much as half their current levels by year 250	• Under the LRMP Scenario, there are significant improvements in the representation of all old-forest ecosystems in protection areas in the gross landbase (GLB; 22.9% to 34.4% protection). • Specific ecosystems are still under-represented (4.3% to 13.7% protection) under the LRMP Scenario including CedarHigh, CedarMed, HemBalHigh, and HemBalMed. The actual area of OG within these same ecosystems in protection areas also remains quite low. • CedarHigh has very low percent old forest (i.e. are at high risk) through time until 250 years when the percent increases. Pattern for HemBal sites is similar, but with higher initial percent of old forest. These ecosystems remain at high risk except over the very long term. CedarMed and HemBalMed also see considerable reduction in old forest through time because of relatively poor representation in protection areas. Spruce high and medium old-forest sites are quite well represented currently and through time. Pine, CedarLow, HemBalLow, and SpruceLow all have high levels of old forest now and into the future; these ecosystems remain at low risk. • Overall the proposed protection areas describe only a portion of the area that is contributing to GMD targets. • Lowered risk can only be achieved over the long term (>150-250 years) and with application of the 70% RONV target for rare and uncommon types.

Value	Baseline Scenario	LRMP Scenario
Biodiversity BEC Variant	• Eight of 11 BEC variants in the NC LRMP are underrepresented in protection areas (0-2.03%;)[NC LMRP GTT 2003] in the Baseline Scenario; only the Alpine tundra, CWHwm, and MHmm receive moderate protection (5-12%). No BEC variant receives protection in the THLB. ➢ Baseline Scenario - All BEC variants at high risk accept the AT which is a low risk, and CWHwm at moderate risk	• All but two BEC variants (i.e. CWHws1, CWHws2 at 2% and 0% respectively) have at least 14% of their area in protection areas with most much higher; five BEC variants have >30% protection. All but 4 variants are well represented (i.e. >12% in protection areas) in the THLB under the LRMP Scenario. • The increase in protection areas with the implementation of the LRMP Scenario suggests risk to most BEC variants is reduced. • Three variants are underrepresented in protection areas and may require special management consideration including: CWHws1, CWHws2, and MHwh. ➢ LRMP Scenario – All BEC variants at moderate to low risk except CWHws1, CWHws2, MHwh, which remain at high risk.

Value	Baseline Scenario	LRMP Scenario
Biodiversity Ecosection	• Three of four ecosections (i.e. Hecate Lowlands, Meziadin Mountains, and Southern Boundary Ranges) are underrepresented in protection areas in the NC LRMP (0-1.07%) and provincially (0.50% to 4%); only the Kitimat Ranges ecosection is adequately represented in the NC LRMP (7.05%) and well represented provincially (21%). ➢ Baseline Scenario – high risk for Hecate Lowlands, Meziadin Mountains, and Southern Boundary, moderate risk for the Kitimat Ranges	• Under the LRMP Scenario, three of four ecosections (i.e. Hecate Lowlands, Kitimat Ranges, and Southern Boundary Ranges) are well represented in protection areas in the NC LRMP (26-49%). Meziadin Mountains remains underrepresented at 10%. ➢ LRMP Scenario – high risk for Meziadin Mountains, low risk for the other three ecosections.

Value	Baseline Scenario	LRMP Scenario
Grizzly Bear	• Under the Baseline Scenario, the relative risk to grizzly bear terrestrial habitat capability is considered low across the entire LRMP plan area, although moderate to high in specific landscape units and watersheds. • Class 1 and class 2 grizzly bear terrestrial habitat capability is not well represented in protection areas in the GLB, and no protection areas occur in the THLB. • The number of estimated bears in protection areas is 15 or 7% of the population. These bear are found almost entirely in the Khutzeymateen Grizzly Bear Sanctuary, which encompasses an area of 44,902 ha of the NC plan area. ➢ Baseline Scenario - Low risk	• Proposed protection areas include substantial portions of 1 of 4 LUs at high risk in the Baseline (Stagoo), and 3 of 8 LUs at moderate risk (Kwinamass, Khyex, Sparkling). For the other LUs without protection, risk to habitat capability remains moderate or high. • Under the LRMP Scenario, protection of class 1 terrestrial habitat capability is approximately four times greater than the Baseline Scenario with 44% potentially included in protection areas. 27% of the class 1 grizzly bear terrestrial habitat capability in the THLB is in proposed protection areas under this scenario. • Under the LRMP Scenario, an estimated 132 bears or 61% of the population are in protection areas. • The additional protection areas in the Kwinamass and Khyex LUs adjacent to the already existing Khutzeymateen Grizzly Bear Sanctuary will maintain a large area of contiguous high value grizzly bear habitat capable of supporting high bear densities. • The GMD proposes reserves for 100% of class 1 habitat and 50% of class 2 habitat, which would substantially reduce risk in LUS that are not in protection areas. ➢ LRMP Scenario – very low risk

Value	Baseline Scenario	LRMP Scenario
Mountain Goat	• Under the Baseline Scenario, 10% of mountain goat winter range is represented in protection areas. The relative risk to mountain goat winter range is considered low or very low in most LUs, with only two LUs (i.e. Kitsault and Pa_aat) at moderate risk. ➢ Baseline Scenario – low risk	• The LRMP Scenario would result in almost four times the area of mountain goat winter range in protection areas (37%) compared to the Baseline Scenario. Proposed protection areas with confirmed high value mountain goat winter range include (but are not limited to): Kshwan, Olh North, Kwinamass, and Chambers East • Generally, risk to mountain goats across the plan area is low as a result of LRMP implementation. Proposed protection areas includes portions of the two LUs at moderate risk in the Baseline (Kitsault and Pa_aat) so likely reduces their risk. ➢ LRMP Scenario – very low risk

Value	Baseline Scenario	LRMP Scenario
Marbled Murrelet	• Under the Baseline Scenario, only 3% of suitable nesting habitat is located in protection areas and none of this occurs in the THLB. • A moderate decline (27-45%) in Marbled Murrelet nesting capacity is expected in 200 years compared to current estimated levels; this translates into a low to moderate risk to Marbled Murrelet populations. However, risk to population persistence is not expected to increase as a result of reduced nesting capacity. ➢ Baseline Scenario – low-moderate risk	• There is a substantial increase in the level of suitable habitat that is in protection areas under the LRMP Scenario, including 28% of Marbled Murrelet habitat in the GLB, and 25% in THLB alone. • The LRMP Scenario should lessen the risk to population nesting capacity as habitat in protection areas cannot be diluted due to industrial development. However, the decline in nesting capacity, and consequently, the population will continue in the THLB. • Careful management of high quality nesting habitat is required in the THLB outside protection areas using strategies such as old-growth retention areas, wildlife tree patches, and riparian reserves, to mitigate risk to Marbled Murrelets. GMD for ecosystem representation, hydroriparian reserves, red and blue listed ecosystems, grizzly bear critical habitat reserves and mountain goat winter range reduce risk to nesting capacity. ➢ LRMP Scenario – low risk

Value	Baseline Scenario	LRMP Scenario
Aquatic and riparian ecosystems	• Floodplains is the only riparian ecosystem type receiving substantial protection (17%). • Lakes and salmon supporting ecosystems are poorly represented in protection areas (1% and 3% respectively). • None of the riparian ecosystems receive any protection in the Baseline Scenario's THLB. ➢ Baseline Scenario: Salmon supporting ecosystems - high risk, Lakes – moderate risk Floodplains – moderate risk	• The implementation of the LRMP Scenario results in a large increase in the area of riparian ecosystems represented in protection areas, including 44% protection for salmon-supporting ecosystems, 34% for lakes, and 76% for floodplain ecosystems. A minimum of 24% of the area of riparian ecosystems occurring in the THLB is included in protection areas with 71% of the floodplain area protected. Chambers East, Khyex, Kwinamaas, and Quaal River are proposed protection areas with high value hydroriparian ecosystems. • Generally, risk to hydroriparian ecosystems would be lower as a result of the LRMP Scenario implementation, compared to the Baseline Scenario. However, specific areas may be at higher risk and require special management consideration because of threatened fish stocks (e.g. Kitsault , Pa_aat River, and Union Lake) or high wildlife values (e.g. extensive floodplains of Skeena and Ecstall River, large wetland complexes). ➢ LRMP Scenario: Salmon supporting ecosystems – moderate risk, Lakes – low risk Floodplains – low risk

Value	Baseline Scenario	LRMP Scenario
Black Bear	• High and very high suitability habitat is underrepresented in protection areas at 3% and 1% respectively under the Baseline Scenario. There is no high suitability black bear habitat in THLB protection area. • Even with low representation of black bear habitat in protection areas, they are widespread throughout the NC LRMP plan area with the exception of the outer coast and some islands. While there are no accurate estimates of North Coast black bear population size, density or trends, the species is not considered at risk ➢ Baseline Scenario – low risk	• Under the LRMP Scenario, there is a substantial increase in the amount of high and very high suitability habitat in protection areas compared to the Baseline Scenario reducing risk to black bear habitat. Very high suitability habitat increases to 41% and 30% in the GLB and THLB, respectively. High suitability habitat increases to 21% and 13% in the GLB and THLB, respectively. Proposed protection areas with high value black bear habitat include (but are not limited to) Kshwan, Kwinamass, Khyex, and Johnston. • Island populations with high incidence of white-phase bears (notably Gribbell, Gil and Hawkesbury) do not receive protection, and are at the same potential risk as in the Baseline Scenario. • Proposed GMDs that would keep risk very low include stand-level retention of old-forest structure in WTPs (for dens), and limits to mid-seral representation at the watershed and landscape scales along with reduced stocking densities for regeneration (to maintain forage availability through a rotation). ➢ LRMP Scenario – very low risk

Value	Baseline Scenario	LRMP Scenario
Moose	• Approximately 13% of primary and secondary moose winter range habitat is in protection areas; none of this protection occurs in the THLB. Of 33 identified moose winter range units, 23 units are considered to be at very low risk and 10 units at low risk ➢ Baseline Scenario – low risk	• A substantial increase in moose winter range protection occurs under the LRMP Scenario with 67% of primary habitat and 42% of secondary habitat protected; 63% and 34% of primary and secondary habitat occurring in the THLB is protected. Proposed protection areas with confirmed high value moose winter range include Kshwan, Kwinamass, Khyex, Khtada, Johnston, and Chambers. • Moose populations are considered at very low risk under the LRMP Scenario and moose populations are expected to increase in the future. However, a few areas of concern with public access development, such as Kitsault and Lachmach-Work Channel may increase risk to moose in some areas. ➢ LRMP Scenario – very low risk

Value	Baseline Scenario	LRMP Scenario
Northern Goshawk	• Currently, high quality goshawk habitat has limited representation in protection areas with only 4% of this raptor's habitat in protection areas. • This limited protection results in high risk to goshawk populations because active management in the THLB will be required to both inventory and maintain nesting habitat. ➢ Baseline Scenario – high risk	• There is a 20% increase in the level of goshawk habitat protection under the LRMP Scenario, compared to the Baseline in the GLB as well as in the THLB alone. Protection areas proposed under the LRMP Scenario with high value goshawk habitat include Chambers East and Khtada West. • The goshawk habitat located in protection areas will help mitigate risk to populations as protection areas will likely conserve full goshawk territories (including nesting and foraging habitat). • Because a relatively high percentage of the THLB (41%) is high quality goshawk nesting habitat, active management will likely be required in the THLB, through approaches such as old-growth management areas, wildlife tree patches, and variable retention strategies, to maintain the mature/old-growth structural stages used as habitat by goshawks and mitigate risk to their populations. ➢ LRMP Scenario – low risk

Value	Baseline Scenario	LRMP Scenario
Rare and threatened ecosystems	• Six blue and red-listed old-growth floodplain and alluvial/colluvial forest ecosystems were analyzed for the NC LRMP planning process • Eleven of 60 LUs in the NC LRMP have some documented overlap between listed ecosystems and the THLB, averaging 6.24%. However this percentage drops to 1.95% if CWHvm1/08 (a relatively common site series) is excluded from the analysis. • Rare and endangered ecosystems are not represented in protection areas in the Baseline Scenario; their area occurs almost entirely in the general management zone. ➢ Baseline Scenario – high risk	• Implementing the LRMP Scenario would result in a substantial increase in the representation of red-listed ecosystems in protection areas (60% representation in the GLB, and 63% of the THLB). A similar level of representation occurs for blue-listed ecosystems when all are included. However, if CWHvm1 is excluded, 22% of the overall area of blue-listed ecosystems is protected in the GLB, and 29% in THLB protection areas. • Given that GMD targets for red and blue-listed species will be met over the plan area, risk to these ecosystems will be low with LRMP implementation. • Proposed GMD includes full protection for all red-listed ecosystems and at least 70% protection of each blue-listed ecosystem unit, other than CWHvm1/08. ➢ LRMP Scenario – very low risk

Value	Baseline Scenario	LRMP Scenario
Tailed Frog	• Under the Baseline Scenario, no optimal tailed frog habitat is represented in protection areas. • Disturbances at the watershed, sub-basin, and stand-level can impact in-stream habitat characteristics and riparian forest microclimatic conditions. Specific concerns include: increased sedimentation and destabilization of in-stream habitat, and the removal of forest canopy cover. These factors can all negative impact tailed frog populations ➢ Baseline Scenario – high risk	• The implementation of the LRMP Scenario results in a relatively large increase in tailed frog optimal habitat in protection areas, including 26% of GLB habitat, and 22% of THLB habitat. • While only 22% of their habitat in the THLB is included in protection areas, the relatively large percentage of stream length that is in the GLB increases the certainty that tailed frog in-stream habitat will be maintained. However, a high percentage of tailed frog optimal habitat is not protected nor affected by management direction to conserve riparian habitat. • Little is known about tailed frog terrestrial habitat requirements and the draft North Coast GMD does not address tailed frog terrestrial habitat. Therefore, mitigative measures may be required along tailed frog streams with high quality habitat to limit the risk to both their in-stream and terrestrial habitat ➢ LRMP Scenario – low-moderate risk

2. INTRODUCTION

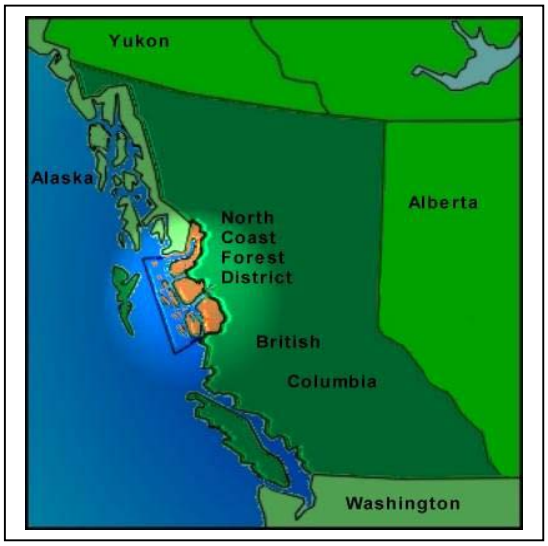
2.1 INTRODUCTION

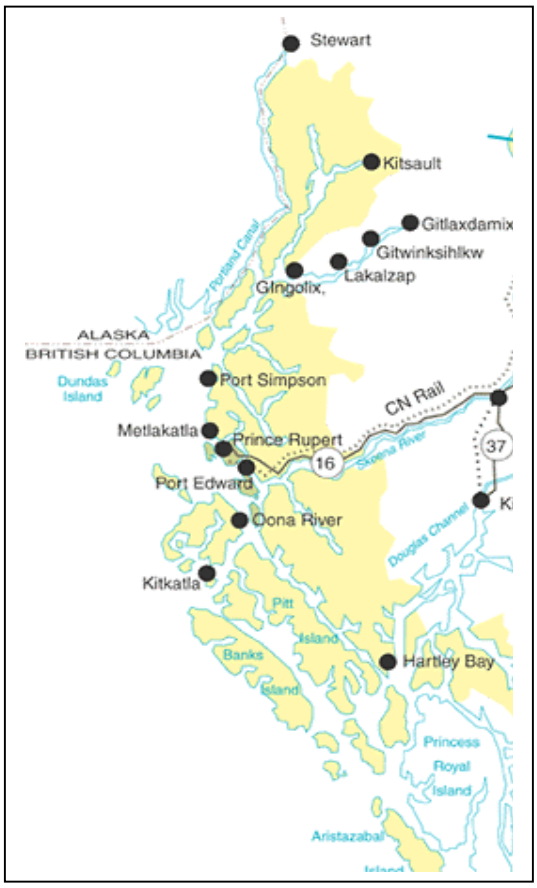
This report is the revised environmental risk assessment (ERA) as a result of agreements made by the North Coast Land and Resource Management Plan Table at the NC LRMP meeting held March 26-28, 2004 [modified from Maxcy and Crane Management Consultants March 2004 Volume II: Environmental Risk Assessment of the "Socio-Economic and Environmental Assessment of Interim Scenarios developed by the North Coast LRMP Table as of January, 2004"]. In the revised ERA analysis, risks to environmental values are summarized for the Baseline Scenario and the LRMP Scenario, agreed to in-principle by the NC LRMP Table at the March 26-28, 2004 table meeting.

The ERA was undertaken in accordance with the SEEA methodologies outlined in the Ministry of Sustainable Resource Management documents entitled *Socio-Economic and Environmental Assessment for Land and Resource Management Planning in British Columbia: Guiding Principles* [Pierce Lefebvre February 2002] and *Socio-Economic and Environmental Impact Assessment for Land and Resource Management Planning in British Columbia* [Holman and Terry November 2001].

2.2 PLAN AREA

The North Coast LRMP area is bounded by the Pacific Ocean to the west and the Coast Mountains in the east. The Skeena River bisects the mainland portion of the plan area. In total the North Coast LRMP plan area covers approximately 1.7 million hectares. Its population in 2001 was approximately 17,000. The following maps show the plan area's provincial location, boundaries and communities.





The North Coast plan area comprises approximately 90% of the North Coast Forest District. The areas excluded from the forest district are the following.

- Princess Royal Island and, part of Tree Farm License (TFL) 25 on the mainland, were included in the Central Coast Land and Coastal Resource Management Plan (CC LCRMP).
- The Nisga'a Lands, comprising 58,068 ha in the north of the plan area.
- Some Skeena River islands, which were addressed in the South Kalum LRMP.

2.3 PURPOSE

The primary purpose of this report is to summarize the environmental implications and relative risks of implementing the LRMP scenario agreed to through the North Coast Land and Resource Management Plan (NC LRMP) process compared to the Baseline Scenario, which assumes current management practices are continued into the future. An environmental risk assessment (ERA) is the tool used to assess risk to selected environmental values. ERAs project risk (i.e., probability) of undesirable outcomes for key environmental values arising from implementation of the LRMP Scenario compared to the Baseline Scenario. The ERA uses a "low risk benchmark[1]" to identify conditions with a high probability of sustaining the environmental value over the long term [MSRM 2001]. Comparing the low risk or natural benchmark to the Baseline and LRMP Scenario is meant to assess how risk to each environmental value changes under the two land use regimes.

2.4 ECOSYSTEM-BASED MANAGEMENT FRAMEWORK

An ecosystem-based management (EBM) framework has been adopted as the strategic approach to guide the North Coast LRMP (NC LRMP) planning process[2]. EBM is a shift from traditional economic-oriented land-use planning to a more holistic approach incorporating a broader range of values. The two broad objectives of ecosystem-based management (EBM) are to [CIT 2003a]:

> "Maintain ecological integrity, where ecological integrity is the abundance and diversity of organisms at all scales, and the ecological patterns, processes, and structural attributes responsible for that biological diversity and for ecosystem resilience."

1 "low-risk benchmark"- the benchmark is usually based on best management practices or the natural disturbance regime i.e. what is expected naturally.

2 The North Coast LRMP Table adopted a set of principles of ecosystem-based management (EBM) to guide its planning process. The goals, objectives, and targets in the North Coast LRM Plan are intended to provide specific guidance for land and resource managers about application of EBM principles to the North Coast planning area. In developing the management direction for the plan, the planning table was guided by best available science and local and traditional knowledge, including First Nations land use plans, the Coast Information Team's EBM Handbook and other reports, research and analysis by the North Coast GTT, and provincial experts in various resource management fields.

> "Achieve high levels of human well-being, where human well-being is a condition in which all members of society are able to determine and meet their needs and have a large range of choices and opportunities to fulfil their potential."

Therefore, in an ideal EBM framework, land-use planning occurs with the intent to maintain ecological integrity while incorporating socio-economic values within ecological constraints [Holt 2001, CIT 2003a]. In the NC LRMP planning process, the selected environmental values are intended as a suite to serve as indicators of ecological integrity.

This document summarizes risk assessments for a suite of environmental values under the LRMP Scenario tentatively agreed to by the NC LRMP Table in which approximately 35% of the NC LRMP area is proposed for protection. It therefore aims to clarify trade-offs in the planning process between maintaining ecological integrity (reducing risk) and meeting other socio-economic objectives.

2.5 METHODOLOGY

Two approaches were employed to analyze impacts to environmental values under the LRMP and Baseline Scenario: (i) North Coast Landscape Model, and (ii) area analysis.

The NC Landscape Model [SELES; Morgan et al. 2002] projects the abundance and distribution of ecosystems and/or habitats through time (0-250 years) for the Baseline Scenario. Domain experts for coarse filter biodiversity, mountain goats, marbled murrelets and grizzly bears assessed the Landscape Model's outputs, quantitatively or qualitatively, to assess risk to these values.

This approach has an advantage over area analysis in that it attempts to model changes in the structure and abundance of forest ecosystems outside protection areas as forest development continues over time. More specifically, it captures the key land use objectives agreed to by the LRMP Table to date, such as retention of critical grizzly bear habitat, riparian reserves around estuaries, floodplains and lakes, and retention of rare and endangered plant communities and then models continued harvesting of old forests over time. In comparison area analysis is somewhat limited in that it does not discriminate forest age, an important component of habitat quality, for some of the environmental values.

Risk assessment approaches for each of the key environmental values are explained in Appendix I.

The area analysis is a Geographical Information System (GIS) analysis that calculates the percent area of each environmental value in each land use zone (e.g. protection areas, general management, community watersheds and private and settlement area). A key comparison is the percentage of the land crucial to an environmental value, which occurs in protection areas in each of the two scenarios summarized for the Gross Landbase (GLB) and the Timber-Harvesting Landbase (THLB).

Table: 2-1: Environmental values assessed and analysis method

Environmental value	Analysis method	Reference
Coarse-filter biodiversity	NCLM[3]; area analysis	Holt and Sutherland (2003) & Holt (March 2004)
Marbled murrelet	NCLM; area analysis	Steventon (2003)
Mountain goat	NCLM; area analysis	Pollard (2003a)
Grizzly bear	NCLM; area analysis	Hamilton and Horn (2003)
Biogeoclimatic (BEC) zone i.e. BEC variant	area analysis	Holt and Sutherland (2003), NC LRMP GTT (2003)
Ecosection	area analysis	NC LRMP GTT (2003)
Black bear	area analysis	MSRM (2003a)
Moose	area analysis	Pollard (2003b)
Rare and threatened ecosystems	area analysis	Ronalds and McClennan (2002)
Northern goshawk	area analysis	Mahon et al. (2003)
Tailed frog	area analysis	MSRM (2003b)
Aquatic and riparian	area analysis	Liepins (2003)

Results are presented for four environmental values (i.e. coarse-filter biodiversity, Marbled Murrelet, mountain goat, and grizzly bear) analyzed using both the NC Landscape Model and the area analysis. This includes a brief description of the value and its importance, the indicators selected to analyze each value, a summary of the results, and a discussion and conclusion. Included in the risk assessment of coarse-filter biodiversity are the area analysis results for BEC variant and Ecosection. Detailed information on the background, analytical methods, limiting assumptions, and results for each of the ERAs can be found in supporting technical reports produced for MSRM (see Table 2-1).

The second section presents results for the remaining environmental values for which only area analysis was conducted (excluding BEC variant and ecosection, which are discussed under coarse filter biodiversity). Detailed background information for each of the values can be found in supporting documents produced for MSRM (see Table 2-1).

Given that the main difference between the Baseline and LRMP Scenario is the area designated for protection, this is the main summary point for each value/indicator, i.e. how the percent area of each value in protection areas changes under the LRMP Scenario, relative to the Baseline Scenario. Other important results are highlighted where appropriate.

2.6 SCENARIOS

An important role for a SEEA is to provide information to the LRMP Table on the implications of alternative management choices. Two scenarios were developed for this analysis, a LRMP Scenario and a Baseline Scenario.

Based on LRMP Table discussions about land use and resource management, especially discussions about designation of new protection areas[4], the LRMP's Government Technical team

[3] North Coast Landscape Model

[4] Another term is natural and cultural areas.

(GTT) devised four alternative land and resource scenarios as the subjects for socio-economic and environmental analyses. Risks to environmental values under these four Scenarios were analyzed in Volume II: Environmental Risk Assessment of the "Socio-Economic and Environmental Assessment of Interim Scenarios developed by the North Coast LRMP Table as of January, 2004" [Maxcy and DeBiasio 2004].

Based on March 26-28, 2004 NC LRMP Table decisions, the intermediate scenario (LRMP Scenario) formed the basis for an agreement-in-principle (AIP). Therefore, in this report only the LRMP Scenario and Baseline Scenario are compared.

As per the requirements of its terms of reference, the North Coast LRMP Table adopted a set of ecosystem-based management (EBM) principles to guide its planning process[5]. The goals, objectives, and targets in the North Coast LRM Plan provide specific guidance for land and resource managers about application of EBM principles to the North Coast planning area. In developing the management direction for the plan, the planning table was guided by best available science, and local and traditional knowledge, including First Nations land use plans, the Coast Information Team's EBM Handbook and other reports, research and analysis by the North Coast GTT, and provincial experts in various resource management fields.

As per MSRM's SEEA methodology a Base Case was analyzed, herein called the Baseline Scenario. For this project, it is the current set of management directions and rules, including the current amount of protection areas. *It is a baseline for analysis and represents neither a status quo option nor an Ecosystem-Based Management (EBM) alternative that is under consideration for future implementation by the BC Government.* The sole purpose of analyzing the Baseline Scenario is to provide information for planning purposes, specifically to inform Table and GTT representatives about socio-economic impacts that are likely to arise from designating additional protection areas and moving to an EBM system of resource management from the current set of management directions and rules.

[5] This approach is consistent with the terms of reference for the NC LRMP and the *General Protocol Agreement on Land Use Planning and Interim Measures* signed in 2001 between the Provincial Government and signatory First Nations. The vision statement for the LRMP affirms this focus: "…The plan will strive to protect, enhance and rehabilitate resources. The plan will also strive to increase economic opportunities and to reflect the diversity of the plan area. It will do this *through the use of an ecosystem-based resource management framework* and through involvement of stakeholders in a balanced and consensus-based process."

The following table summarizes the Baseline and LRMP Scenarios analysed in this current report.

Table: 2-2 SEEA Scenarios

Name	Protection Area Description	Protection Area's Share of Gross Land Base	Fine Filter	Old Seral Representation Targets
Baseline Scenario	Current protection areas	~ 3%	Current management	Current management
LRMP Scenario	Current protection areas + new protection areas under discussion at March 26-28 Table meeting	~ 36%	Draft LRMP Fine Filter Parameters	Old seral representation targets: 30% - common BEC AUs and 70% - uncommon BEC AUs

3. COARSE FILTER BIODIVERSITY[6]

3.1 BACKGROUND

The North Coast LRMP planning area is part of the globally rare coastal temperate rainforest biome. British Columbia, and in particular, the North Coast, have some of the last remaining undeveloped tracts of temperate rainforest in the world. Coastal forests often comprise upward of 90% old-growth forest over time-scales of centuries due to infrequent stand-replacing disturbances (such as fires). Small-scale gap phase dynamics[7], and the mild, wet climate result in productive forests characterized by uneven aged, structurally complex stands of large trees, snags, and coarse-woody debris (CWD), and tremendous accumulations of biomass.

These structurally complex old forests are rich in biodiversity that includes diversity of genes, populations of species, and ecosystems. Most elements of biodiversity in temperate rainforests are poorly studied, difficult to observe, and/or unknown, such as soil microbes, arthropods or fungi. Therefore, surrogate measures of biodiversity are used in land-use planning and management to maintain the majority of biodiversity elements in the landbase.

"Coarse-filter" management is one of the primary approaches recommended for maintaining biodiversity [Franklin 1993; O'Neil 1995; Noss 1999].

Several approaches have been identified to meet coarse-filter objectives; these may be broadly categorized as "ecosystem-based" approaches and "species-based" approaches. One ecosystem-based approach for managing coarse-filter biodiversity objectives is ecological representation of ecosystem-based units (i.e. ecosystems defined by certain criteria such as vegetation and/or wildlife communities, geomorphology, climate, or a combination of these). Ecological representation is increasingly considered one of the most important criteria to ensure the persistence of biological diversity and ecosystem function [O'Neil 1995; Noss 1999].

Ecosystem representation is one of the main goals of the EBM framework for management of BC's coastal ecosystems [CIT 2003b]. The EBM framework uses strategies such as protection areas and seral stage distribution targets, for example, to manage for coarse-filter biological diversity. Natural disturbance regimes of coastal forests form the foundation of the entire model for representation targets. The EBM Handbook [CIT 2003a] provides representation targets for the coarse filter at territory/ subregional, landscape, watershed and stand levels, with increasing flexibility at smaller scales (i.e. lower targets at each lower scale). The goal at the regional and territory/subregional scales is to maintain the abundance of each old-forest ecosystem within 70% of what is expected naturally so that there is a high probability of maintaining ecological integrity [CIT 2003b]. At smaller spatial scales, retention targets of old seral stages are lower ranging

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6 The analysis in this chapter on coarse filter biodiversity is based on a MSRM generated GIS area statistics that compare how much area of a biodiversity indicator was included in protection areas under the Baseline Scenario and the LRMP Scenario and interpretive modelling of biodiversity impacts that incorporates timber supply estimates by a MSRM commissioned consultant [Holt March 2004]. The latter document is extensively relied upon for some parts of the chapter's interpretations and analysis.

7 Gap-phase dynamics – the predominant disturbance agent in the NC as a result of tree deaths creating gaps in the canopy on a scale of meters to several hundred hectares [Dorner and Wong 2003]

from a minimum of 15% at the stand-scale to a minimum of 30% at the watershed scale, and 50% at the landscape-scale as long as the regional target of 70% is met.

To assess the implications of the Baseline Scenario and LRMP Scenario on coarse-filter biodiversity values in the NC planning area, ecosystem representation (i.e. old forest ecosystems defined by leading tree species and site productivity) was analyzed using the NC Landscape model and area analysis. In addition, area analysis results for BEC variants and Ecosections are also presented.

3.2 INDICATORS

The primary indicator of coarse-filter biodiversity for the NC LRMP process is ecosystem representation using old-forest ecosystems as representative units (Table 3.1). Representation of old forest ecosystems is considered an appropriate indicator of coarse-filter biological diversity for a number of reasons:

- in all coastal forest ecosystems natural disturbance patterns result primarily in old forest [Dorner and Wong 2003]
- key structural elements such as large, old trees, large accumulations of biomass, large snags and CWD (coarse woody debris) are a consequence of infrequent, large-scale stand replacing disturbances; these structural elements are difficult to maintain in the harvested landbase
- many components of coastal forest biodiversity (e.g. arthropods, plants) are adapted to old forest conditions

Table 3-1: Coarse-filter biodiversity ERA indicators

Indicator	Rationale	Evaluation of risk
Abundance and extent of old-forest by AU x BEC variant	Natural disturbance patterns result primarily in old-forest to which most components of biodiversity are adapted	Compared predicted abundance of old-forest ecosystems under natural disturbance to amount in each modeling scenario at each time period Risk increases as the abundance of old-forest ecosystems deviates from expected natural disturbance patterns

Productivity groups or analysis units (AUs) form the main indicator used to assess the implications of the NC LRMP Scenario on coarse-filter biodiversity. AUs are based on the leading tree species and site productivity (high, medium, low) of a stand [Holt and Sutherland 2003]. The main productivity groups or AUs in the North Coast plan area are: Cedar/Hemlock (CH) high, medium and low productivity sites; Hemlock/Balsam (HB) high, medium, and low sites; Spruce (S) high, medium, and low sites; Pine (P) sites. While AUs form the main unit of comparison, they are not defined as ecosystems. Old-forest ecosystems are actually defined by AUs within a biogeoclimatic (BEC) variant (AU x BEC) [Holt and Sutherland 2003]. AUs are the main focus of the results section to simplify the presentation and discussion of implications to coarse-filter biodiversity as a result of LRMP implementation.

Old forest ecosystems were analyzed using four main comparisons:

1. Old forest ecosystems were assigned a risk class (very low, low, medium, high, and very high) based on the extent to which the current abundance of old forest for each forest ecosystem deviated from the expected abundance of old forest resulting from natural disturbance regimes [Holt and Sutherland 2003]. Ecosystems in each risk group were analyzed in the GIS area analysis comparing how much of their area was included in protection areas under the Baseline Scenario and LRMP Scenario.

2. The total representation of each productivity group (AU), irrespective of age, captured in protection areas under the Baseline Scenario and LRMP Scenario.

3. The total representation of old forest within each productivity group (AU) that was included in protection areas under the Baseline Scenario and LRMP Scenario.

4. Total representation of old forest in each productivity group in protection areas and the managed landbase predicted through time under the Baseline Scenario and LRMP Scenario.

Each of the questions above individually provides some of the answer, but each requires the full picture in order for the benefits to the coarse filter to be understood fully. It is not adequate to consider only the Analysis Unit totals, but these are provided in the text for ease of reading. However, the full ecosystem representation analysis is commented on in the key points, and data are available in Appendix II for each AU x BEC. Area summaries are presented at this stage, rather than a risk analysis. This is because the five risk classes are broad and do not provide fine enough resolution to distinguish between options at this stage. For example, cedar high analysis units are always high risk though the amount captured in each scenario differs. However, risk can be inferred from the comparison of the percent of old forest for each ecosystem over the entire landbase through time (see question 4 above).

3.3 IMPACT

3.3.1 Old-Forest Ecosystems

3.3.1.1 Indicator Results

1) Total representation of old-forest ecosystems by risk group in protection areas.

Table 3.2 presents area analysis results for the following.

- Area of old-forest ecosystems in the GLB and THLB by risk level[8] and scenario
- Percentage of old-forest ecosystems, irrespective of age, in current or proposed protection areas by risk level and scenario

[8] Risk categories were assessed to each ecosystem at time zero under the Baseline Scenario using the NC Landscape Model [Holt and Sutherland 2003].

Table 3-2: Percentage of old-forest ecosystems, irrespective of age, in current or proposed protection areas by risk level and scenario.

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Very High risk ecosystem GLB area	9,199 ha	9%	30%
Very High risk ecosystem THLB area	6,192 ha	0%	17%
High risk ecosystem GLB area	3,093 ha	12%	26%
High risk ecosystem THLB area	1,923 ha	0%	12%
Medium risk ecosystem GLB area	88,723 ha	4%	23%
Medium risk ecosystem THLB area	32,028 ha	0%	18%
Low risk ecosystem GLB area	70,520 ha	7%	34%
Low risk ecosystem THLB area	21,059 ha	0%	22%
Very low risk ecosystem GLB area	903,088 ha	2%	29%
Very low risk ecosystem THLB area	61,337 ha	0%	24%

Source: MSRM

2) Total representation of ecosystems in protection areas.

Table 3.3 presents area analysis results for the following.

- Percentage of each ecosystem (Analysis Unit) in current or proposed protection areas by scenario irrespective of stand age.

Table 3-3: Total representation of ecosystems (Analysis Units) in protection areas, irrespective of age of stands.

Indicator	Scenarios	
	Baseline	LRMP
	% Share in Current and Proposed Protection Areas	
CedarHigh Total	0.9	4.3
CedarLow Total	1.2	20.8
CedarMed Total	1.4	8.1
Cottonwood Total	2.6	24.2
HemBalHigh Total	1.1	8.5
HemBalLow Total	3.6	26.7
HemBalMed Total	3.4	13.7
OtherDecid Total	3.1	20.4
Pine Total	0.2	46.3
SpruceHigh Total	12.2	28.9
SpruceLow Total	6.0	29.0
SpruceMed Total	7.1	25.1
Grand Total	1.9	22.8

Shaded cells are those with under-representation, relative to the overall percentage captured in each scenario.

Source: Holt March 2004

3) Total representation of old forest within each ecosystem in protection areas.

Figure 3.1 presents area analysis results for the following.

- The percentage of old forest within each ecosystem (Analysis Unit) that is included in current or proposed protection areas by Scenario.

- The black line is the overall total percent old forest captured. Ecosystems below the line (cedar hemlock high, etc) are under-represented compared with the total, and ecosystems above the line are over-represented.

- The shape of the curve shows the additional old forest captured in each scenario.

- All ecosystems have very low representation of old forest in protection areas in the Baseline Scenario (because the amount of protection areas is very low).

- Ecosystems then differ in the extent of representation across three levels of risk (protection) that were presented in the March 2004 ERA Final Draft. The Scenario referenced as MED in the figure is equivalent to the LRMP Scenario. Some ecosystems are well represented across the low, medium and high (e.g. pine) scenarios and others are not well represented until the medium or high PA scenarios (e.g. spruce medium), and others never become well represented (cedar / hemlock high and medium, hemlock / balsam high and medium).

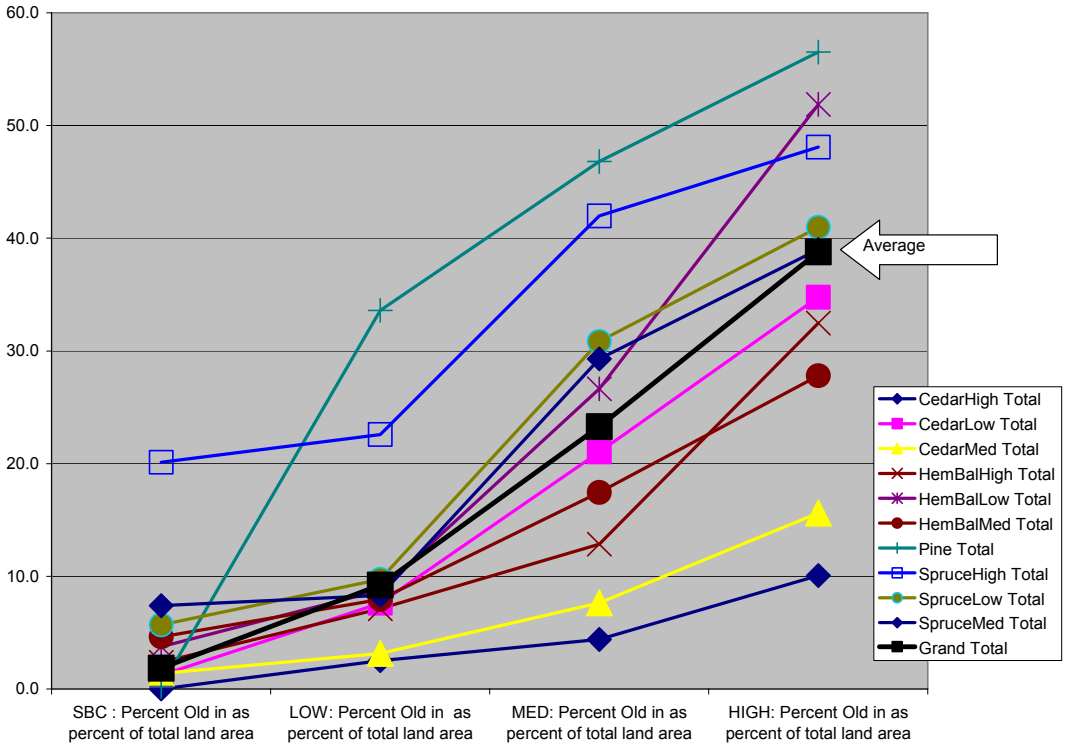

Figure 3.1. The percentage of old forest within each ecosystem (Analysis Unit) that is included in current or proposed protection areas by scenario [Source: Holt March 2004].

4) Old-forest in the LRMP landbase

Table 3.4 presents area analysis results for the following.

- Percentage of old-forest within each ecosystem (Analysis Unit) through time (0-250 years) under the Baseline and LRMP Scenario in the LRMP landbase.

Table 3-4: Percent of old forest (as percent of ecosystem area) for each ecosystem in the Baseline and LRMP Scenario and through time.

Year	Analysis Unit	Scenarios			
		Baseline	LRMP 1	LRMP 2	LRMP 3
		% of old forest in the LRMP landbase			
0	CedarHigh	9	9	9	9
20	CedarHigh	7	6	7	7
50	CedarHigh	5	5	5	6
100	CedarHigh	4	4	5	6
150	CedarHigh	4	4	4	6
200	CedarHigh	4	7	7	9
250	CedarHigh	4	10	13	33
0	CedarLow	97	97	97	97
20	CedarLow	97	97	97	97
50	CedarLow	96	96	96	96
100	CedarLow	93	93	94	94
150	CedarLow	92	93	93	94
200	CedarLow	92	92	93	94
250	CedarLow	92	92	93	94
0	CedarMed	84	84	84	84
20	CedarMed	78	77	77	78
50	CedarMed	61	60	61	66
100	CedarMed	45	47	50	56
150	CedarMed	40	44	48	55
200	CedarMed	40	44	48	55
250	CedarMed	40	44	48	56
0	HemBalHigh	28	28	28	28
20	HemBalHigh	22	23	24	28
50	HemBalHigh	21	22	23	29
100	HemBalHigh	20	21	23	30
150	HemBalHigh	17	19	22	30
200	HemBalHigh	17	20	23	32
250	HemBalHigh	17	23	29	50
0	HemBalLow	89	89	89	89
20	HemBalLow	87	87	87	88
50	HemBalLow	85	85	85	87
100	HemBalLow	79	80	82	85
150	HemBalLow	77	78	81	84
200	HemBalLow	77	78	81	84
250	HemBalLow	77	78	81	85
0	HemBalMed	64	64	64	64
20	HemBalMed	56	55	56	59
50	HemBalMed	44	45	47	55
100	HemBalMed	36	38	43	52
150	HemBalMed	32	35	40	52
200	HemBalMed	31	35	40	52
250	HemBalMed	31	36	42	58
0	Pine	99	99	99	99

Year	Analysis Unit	Scenarios			
		Baseline	LRMP 1	LRMP 2	LRMP 3
		% of old forest in the LRMP landbase			
20	Pine	99	99	99	99
50	Pine	99	99	99	99
100	Pine	99	99	99	99
150	Pine	99	99	99	99
200	Pine	99	99	99	99
250	Pine	99	99	99	99
0	SpruceHigh	53	53	53	53
20	SpruceHigh	47	49	50	51
50	SpruceHigh	47	48	49	51
100	SpruceHigh	45	46	49	52
150	SpruceHigh	41	44	50	52
200	SpruceHigh	41	45	50	53
250	SpruceHigh	41	45	51	60
0	SpruceLow	68	68	68	68
20	SpruceLow	67	66	67	66
50	SpruceLow	63	62	64	66
100	SpruceLow	59	59	61	64
150	SpruceLow	51	55	60	62
200	SpruceLow	51	55	60	62
250	SpruceLow	51	55	60	64
0	SpruceMed	56	56	56	56
20	SpruceMed	48	50	51	53
50	SpruceMed	43	45	49	52
100	SpruceMed	41	42	49	53
150	SpruceMed	31	38	48	53
200	SpruceMed	31	38	48	52
250	SpruceMed	31	39	49	57

Source: Holt March 2004

- For each set of AUs, the amount of old forest shown at time zero is a combination of that in protection areas, and that in the remaining landbase. At time zero for all cases the amount of old forest is the same under the Baseline and LRMP Scenario (i.e. the total percentage remaining in the whole landbase).

- As time progresses (through to 250 years) the effect of the additional protection areas can be seen as a discrepancy in amount of old forest remaining [Maxcy and Crane March 2004]. This demonstrates the timeframe at which the protection areas start to influence the amount of old forest, and therefore risk. The accuracy of this temporal aspect is dependent on the realism of the harvesting assumptions used in the SELES harvest model.

3.3.1.2 Indicator Results Discussion

➢ There are substantial increases in the proportion of GLB and THLB area of old-forest ecosystems (regardless of risk level) under protection for the LRMP Scenario compared to the Baseline Scenario. However, specific ecosystems (Analysis Units) are under-represented in protection areas under the LRMP Scenario (e.g. CedarHigh, CedarMed, HemBalHigh). Further, the current representation of old forests within these same ecosystems in protection areas is generally low. Representation of old forests in the landbase generally does not increase with the implementation of the LRMP Scenario through time until 250 years when currently harvested stands become old. Therefore protection areas provide increased

certainty about lower risk in the future but do not lower current risk for medium and high risk ecosystems.

- The low risk target for the General Management Direction (GMD) of representation of old forest ecosystems is to maintain 70% of the expected spatial extent of the range of natural variability (RONV) of each ecosystem at the Plan Area scale. Under a risk-managed strategy, old-seral ecosystem representation of 50% at the Landscape Unit (LU) scale and 30% at the watershed scale can be applied, as long as the 70% of RONV target is met over the LRMP area. This is expressed in the GMD for Coarse Filter Biodiversity to allow flexibility in management planning while maintaining a low risk threshold to ecological integrity at the plan level.

  The LRMP Scenario approaches 30% retention of old seral at the plan level via increasing the amount of area considered for protection. Of greatest concern are the high and very high risk ecosystems that encompass a relatively small portion of the NC planning area but have a disproportionately high ecological value, such as CedarHigh and HembalHigh. *Given the limited areal extent of high and very high risk ecosystems in the THLB, management options that minimize harvesting in these ecosystems may not unduly constrain timber production while maintaining a low risk threshold in these productive areas.* Also of concern are the units that are currently at low or medium risk but will become high risk in the short term. These are usually medium productivity units that make of the large part of the landbase, such as CedarMed and SpruceMed.

  Overall the proposed protection areas describe only a portion of the area that is contributing to GMD targets. The remaining contribution occurs in the THLB and may be partially met through other GMD targets for focal species, hydroriparian and stand-level retention strategies that will likely lower risk to ecological integrity at the Plan area scale.

- Other specific coarse filter biodiversity GMD targets relate to maintaining ecological function and processes in the managed landbase, such as maintaining the frequency distribution of seral stages similar to patterns produced by the natural disturbance regime, and maintaining structural attributes (e.g. large trees, snags, CWD) important to wildlife. The recovery / restoration of structural and functional characteristics of old-forest ecosystems that are currently below the low risk GMD threshold is also an objective. Other strategies (in addition to protection areas), are required to lower, minimize, or mitigate risks to old-forest ecosystems, such as increased rotation lengths, thinning of second-growth to achieve old-growth forest characteristics, and partial harvesting.

- ***Baseline Scenario*** – The percent of AUs, in protection areas is low for most AUs, ranging from 0% to 12% protection (Table 3.3). There is no representation of any old forest ecosystem in protection areas in the THLB under the Baseline Scenario. When amount of old forest across the landbase through time is considered, the amount of old forest for many of the ecosystems decreases. The highest reductions are in high productivity units (which start low and become lower), and for medium productivity ecosystems in which old forest area declines by as much as half their current levels by year 250 (Table 3.4).

- ***LRMP Scenario*** - Under the LRMP Scenario, there are significant improvements in the representation of all ecosystems in protection areas in the GLB (22.9% to 34.4% protection), and specifically in the THLB (12.4% to 23.7% protection) (Table 3.2). However, specific ecosystems are under-represented (4.3% to 13.7% protection) under the LRMP Scenario including (Table 3.3): CedarHigh, CedarMed, HemBalHigh, and HemBalMed. The actual area of old forest within these same ecosystems represented in protection areas also remains low (Figure 3.1). The area of each ecosystem maintained as old forest through time in the entire landbase declines slightly for most ecosystems but declines are not as great as observed in the Baseline Scenario. However, representation of the CedarHigh ecosystem is very low, and substantial declines in the area of old forest within the HemBalMed and CedarMed also occur. Incremental to existing protection areas, additional representation of moderate to very high risk old forest ecosystems in protection areas includes (but is not limited to): Ohl North, Kwinamass, and Khyex.

3.4 OLD-FOREST CONCLUSIONS

Overall, there is an increase in area of old-forest under protection with the implementation of LRMP Scenario compared to the Baseline Scenario. However, risks to specific ecosystems (i.e. CedarHigh, CedarMed, HemBalHigh, HemBalMed) remain high, even under the LRMP Scenario because of under-representation in protection areas, and limited recruitment or loss of old forest within these ecosystems through time.

- Generally, old forest in all ecosystems continues to be reduced through time, but these declines are not as great under the LRMP Scenario compared to the Baseline Scenario. Only under high levels of protection (e.g. 55% proposed under LRMP Scenario 3) results in a higher final amount of old forest in the landbase. However, over time this is not as different as might be expected for most ecosystems, due to continued harvesting outside protection areas.

- The difference in the amount of old forest under the LRMP Scenario compared to the Baseline Scenario does not become apparent for most ecosystems until a long time into the future. Protection areas therefore provide increased certainty about lower risk in the future, but do nothing to decrease current and short-term risk.

- CedarHigh has very low percent old forest (i.e. are at high risk) under both the Baseline and LRMP Scenarios and through time until 250 years when the percent increases (currently harvested stands finally become 250 years old). Pattern for HemBal sites is similar, but with higher initial percent of old forest. These ecosystems remain at high risk irrespective of scenario, except over the very long term. Total protection of remaining old forest and restoration would likely be required to reduce the risk for these ecosystems in the short-term. The actual area involved for these units is very small, which is why they tend not to be captured in a few larger protection areas.

- These summary figures for CedarMed and HemBalMed sites mask some variation that is apparent at the finer resolution (AU x BEC; Appendix 2). The medium productivity sites also see considerable reduction in old forest through time in both scenarios, and the total effect of protection areas is relatively low (i.e. the difference in drawdown is relatively small

across the scenarios). This reflects relatively poor representation in protection areas for these ecosystem types.

- Spruce high and medium sites are quite well represented in both scenarios, and through time. This reflects riparian management, which is modelled in all scenarios. The extent to which they continue to function however will be dependent on other factors such as size of riparian buffers, lack of high-grading within buffers and windfirmness of remaining buffers (i.e. the model assumes no windthrow).

- Pine, CedarLow, HemBalLow, and SpruceLow all have high levels of old forest now and into the future, irrespective of LRMP Scenario. These ecosystems remain at low risk.

- Re the GMD impact Reid concludes "Even with hydroriparian and fine filter management, high and very high risk old growth units remain so in the short-term until they can age and regrow to old growth status. Lowered risk can only be achieved over the long term (>150 - 200 years) and with application of the 70% RONV target for retention for rare and uncommon types." [April 2004]

3.4.1 BEC Variant

3.4.1.1 Indicator Results

Table 3-1 presents area analysis results for the following.

- Area of BEC variants in the GLB and THLB by Scenario
- Percentage of BEC variants in current or proposed protection areas by Scenario

In this table, the cells are colour coded to indicate percent area of each BEC variant included in protection areas by Scenario. Red is high risk, yellow is intermediate risk and green is low risk as per the following chart.

% of RONV and Risk Resultant	0-30%	30-70%	70-100%

Table: 3-1: BEC variants indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
By Gross Land Base			
AT GLB	126,868 ha	5%	57%
CWHvh2 GLB	709,655 ha	1%	25%
CWHvm GLB	242,032 ha	2%	53%
CWHvm1 GLB	36,720 ha	0%	22%
CWHvm2 GLB	31,212 ha	0%	26%
CWHwm GLB	102,733 ha	12%	38%
CWHws1 GLB	6,548 ha	0%	2%
CWHws2 GLB	12,343 ha	0%	0%
MHmm1 GLB	272,903 ha	8%	50%
MHmm2 GLB	39,609 ha	0%	31%
MHwh GLB	114,857 ha	1%	14%
Within the Timber Harvesting Land Base			

AT THLB	0 ha	na	na
CWHvh2 THLB	53,065 ha	0%	10%
CWHvm THLB	43,496 ha	0%	41%
CWHvm1 THLB	13,085 ha	0%	17%
CWHvm2 THLB	1,232 ha	0%	11%
CWHwm THLB	7,272 ha	0%	23%
CWHws1 THLB	2,883 ha	0%	2%
CWHws2 THLB	3,925 ha	0%	0%
MHmm1 THLB	1,815 ha	0%	19%
MHmm2 THLB	755 ha	0%	0%
MHwh THLB	2,426 ha	0%	6%

Source: MSRM

3.4.1.2 Indicator Results Discussion

➢ There are substantial increases in the proportion of GLB and THLB area for most BEC variants under protection for the LRMP Scenario compared to the Baseline Scenario.

- *Although the GMD for Coarse Filter Biodiversity recommends monitoring ecosystem representation at the site series (BEC ecosystem) level, the information to evaluate the plan scenarios does not currently exist to that level of detail across management units. Therefore, the table above describing ecosystem representation to the variant level is an estimate or proxy for information within the variant as a site series aggregate, and should not be considered as adequate to meet the detailed information requirements considered in the GMD.*

- ***Baseline Scenario*** - Eight of 11 BEC variants in the NC LRMP are underrepresented[9] in protection areas [0-2.03%; NC LMRP GTT 2003] in the Baseline Scenario; only the Alpine tundra, CWHwm, and MHmm receive moderate protection (5-12%). No BEC variant receives protection in the THLB.

- ***LRMP Scenario*** - All but two BEC variants (i.e. CWHws1, CWHws2 at 2% and 0% respectively) have at least 14% of their area in protection areas with most much higher; five BEC variants have >30% protection. All but four variants are well represented (i.e. >12% in protection areas) in the THLB under the LRMP Scenario.

3.5 BEC VARIANT CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests risk to most BEC variants is reduced compared to the Baseline Scenario.

Ecosystem representation of most variants in protection areas under the LRMP Scenario is at least 10% higher than the Protected Area Strategy 12% provincial target (22% to 57%). However, a few variants are underrepresented in protection areas and may require special management consideration (e.g. CWHws1 and CWHws2). Three BEC variants, CWHvh2 and CWHvm1 and

[9] Representation was based on the low and high risk thresholds recommended by the Ecosystem-based Management Handbook [CIT 2003a]. The low risk threshold recommends maintaining at least 70% of the area of old-forest that is expected naturally. The high risk threshold recommends maintaining at least 30% of the area of old-forests that is expected naturally. If the area of BEC variant included in protection areas is below the high risk threshold, it is considered under-represented.

vm2 have proportionally large areas occurring in the THLB but little protection there even though they are adequately represented in protection areas overall; therefore, these variants may also require special management consideration to minimize or mitigate their risk under the LRMP Scenario. For all BEC variants, careful planning in the remaining THLB using approaches consistent with those expressed in the GMDs, such as maintaining seral stage distribution similar to patterns produced by natural disturbance regimes, spatial/temporal harvesting schedule, and variable retention strategies, can be further minimise risk to BEC variants.

Re the GMD impact, Reid concludes "Hydroriparian and fine filter management does not augment the area of any BEC variant in protection areas…Hydroriparian and fine filter management does set up additional forest reserves in old growth state in all BEC variants. This increase will be, at most, a few percentage points of the area of any variant, so will have small effect on level of representation." [April 2004]

The following are the summary assessments about the overall risk of the Baseline and LRMP Scenario on BEC variants.

- Baseline Scenario – all BEC variants at high risk except AT, which is at low risk.
- LRMP Scenario – All BEC variants at moderate or low risk except CWHws1, CWHws2, MHwh, which are at high risk, and AT, which is at low risk

3.5.1 Ecosection

3.5.1.1 Indicator Results

The following table presents area analysis results for the following.

- Area of ecosection in the GLB and THLB by Scenario
- Percentage of ecosection in current or proposed protection areas by Scenario

Table: 3-2: Ecosection indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Hecate Lowlands GLB	724,828	1%	26%
Hecate Lowlands THLB	46,734	0%	10%
Kitimat Ranges GLB	611,810	7%	49%
Kitimat Ranges THLB	63,913	0%	33%
Meziadin Mountains GLB	67,447	0%	10%
Meziadin Mountains THLB	8,054	0%	1%
Southern Boundary Ranges GLB	281,996	0%	34%
Southern Boundary Ranges THLB	11,241	0%	16%

Source: MSRM

3.5.1.2 Indicator Results Discussion

➢ There are substantial increases in the proportion of GLB and THLB area in protection areas for all ecosections but the Meziadin Mountains ecosection under the LRMP Scenario compared to the Baseline Scenario.

- ***Baseline Scenario*** - Three of four ecosections (i.e. Hecate Lowlands, Meziadin Mountains, and Southern Boundary Ranges) are underrepresented in protection areas in the NC LRMP (0-1.07%) and provincially (0.50% to 4%); only the Kitimat Ranges ecosection is adequately represented in the NC LRMP (7.05%) and well represented provincially (21%; NC LRMP GTT 2003).

- ***LRMP Scenario*** - Under the LRMP Scenario, three of four ecosections (i.e. Hecate Lowlands, Kitimat Ranges, and Southern Boundary Ranges) are well represented in protection areas in the NC LRMP (26-49%). Meziadin Mountains remains underrepresented at 10%.

3.6 ECOSECTION CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests risk is reduced to all ecosections but the Meziadin Mountains Ecosection.

Re GMD impact, Reid concludes "Hydroriparian and fine filter management does not augment the area of any BEC variant in protection areas…Hydroriparian and fine filter management does set up additional forest reserves in old growth state in all BEC variants. This increase will be, at most, a few percentage points of the area of any variant, so will have small effect on level of representation." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on ecosections.

- Baseline Scenario – high risk for Hecate Lowlands, Meziadin Mountains, and Southern Boundary, moderate risk for the Kitimat Ranges

- LRMP Scenario – high risk for Meziadin Mountains, low risk for the other three ecosections.

3.7 GENERAL CONCLUSIONS ON BIODIVERSITY

Overall, at the BEC variant scale and Ecosection scale, increased area in protection for all ecosystems suggests decreased risk. The risk to old-forest ecosystems could not be assessed because it is unknown how the THLB will be managed under the LRMP Scenario. Further, Holt and Sutherland [2003] identified several AU x BEC units, i.e. old-forest ecosystems defined at the finest scale, that are currently at high or very high risk, and several AU x BEC units at lower risk with risk increasing quickly through time. These old-forest ecosystems were not analyzed in the area analysis but will require consideration in management. Overall, protection areas provide greater certainty that ecological values will be maintained through time.

4. GRIZZLY BEAR

4.1 BACKGROUND

Grizzly bears are an important consideration in land-use planning for a number of reasons [Hamilton and Horn 2003]:

- The North Coast LRMP plan area overlaps significantly with four grizzly bear population units (GBPUs; Stewart, Khutzeymateen, North Coast, and Kitlope-Fjordland), and to a lesser degree with two GBPUs (Cranberry and Bulkley-Lakes). Populations in each GBPU are considered viable.
- Grizzly bears occur at low densities, occupy large home ranges, and require a variety of habitats at different spatial scales (e.g. landscape, watershed, stand-level) to meet their requirements for foraging, reproduction, security cover, thermal cover, and space. They are also sensitive to human disturbance. These characteristics require that grizzly bear management occurs over large, regional scales.
- Managing for grizzly bear habitat may also meet other ecosystem-based management objectives as grizzly bears are considered an umbrella[10] species and a keystone[11] species.
- The social value of the grizzly bear is significant because of its importance to First Nations and its symbolism of coastal wilderness. It is also an important "flagship" species for environmental organizations, aiding to increase public awareness about environmental issues.
- The Khutzeymateen Grizzly Bear Sanctuary, established in 1994 as a cooperative effort between the BC government and Gitsi'is Tribe of the Allied Tsimshian Tribes of Lax Kw'alaams, is the first and only grizzly bear sanctuary in Canada; it is also the largest protection area occurring in the North Coast LRMP plan area at the present time [NC LRMP GTT 2003].
- Approximately one-quarter of the North American grizzly bear population occurs in British Columbia where they are blue-listed, meaning populations are vulnerable and "at risk".
- Grizzly bears formerly occupied much of British Columbia but its range has decreased, particularly in south and south-central British Columbia, and around areas of human habitation. Relatively high densities of grizzly bears still occur in the North Coast, providing a clear current opportunity for conservation.
- Grizzly bears are designated an "identified wildlife" species as part of the Identified Wildlife Management Strategy [IWMS 2004]. Therefore, bear requirements should be considered at the landscape and stand-level during land-use and resource planning.

[10] Grizzly bear populations on the coast may be considered umbrella species due to their large area requirements and the diversity of habitats they use; management for their habitat requirements will also encompass the needs of other species.

[11] Grizzly bear use of spawning salmon with consequent effects on nutrient dynamics, as well as their predator-prey relationships, suggest they are a keystone species of coastal ecosystems; that is, a species that has a disproportionately large impact on their environment relative to their abundance [Simberloff 1998].

4.2 INDICATORS

To investigate potential effects of alternative land-use management plans on grizzly bear populations in the NC plan area, five indicators of grizzly bear habitat (Table 4-1) were analyzed in the Baseline risk assessment (Hamilton and Horn 2003):

- critical habitat supply
- landscape-level forage supply
- risk of displacement from preferred habitats due to roads and road use
- risk of habituation and/or displacement from preferred habitats due to recreation and tourism use
- risk of bear mortality due to roads and concentrations of human activity

Table 4-1: Grizzly bear ERA indicators[12]

Indicator Type	Indicator & measurement unit	Rationale	Evaluation of risk
Critical habitat supply[13]	proportion of the total critical habitat that overlaps with the timber harvesting landbase (THLB) proportion of the THLB that is composed of critical habitat	a decrease in the availability and/or quality of critical habitat that is required to meet life requisites (e.g. foraging, thermal, reproductive requirements) on a seasonal basis, can negatively impact grizzly bears	risk increases as the overlap between critical habitat and the THLB increases risk increases the higher the proportion of THLB that is critical habitat
landscape-level forage supply	ratio of the THLB to total forested landbase seral stage distribution number, distribution, and density of grizzly bears	young and old seral forests have appropriate environmental conditions for the development of understory vegetation layers which serves a food source for grizzly bears, unlike mid-seral forests (approximately 20 to 100 years of age)	risk increases as a greater proportion of the total habitat supply is managed forest with short rotations risk increases as the amount of mid-seral forests increases in a watershed or LU
Displacement risk due to roads	measuring the change in active km of road (total km of roads) road density (km/km2; > 0.6 km/km2 displaces bears)	Roads can have a number of negative consequences to grizzly bears: • direct habitat loss • bear displacement from habitat surrounding roads, • high-traffic roads bisecting home ranges and populations, • increased mortality risk	risk of displacement increases as length of active road increases risk of displacement increases as road density increases

[12] Indicators of risk to grizzly bears used in the Baseline risk assessment [Hamilton and Horn 2003]

[13] Risk to critical habitat assessed outside protection areas

Displacement risk due to recreation and tourism activity	number of user-days for land-based activities occurring in grizzly bear habitat	concentrated recreational and tourism use can result in bear displacement or bear habituation, both of which may have negative consequences	Risk of displacement and likelihood of habituation increases when: • high number of user days overlap with areas of high quality grizzly bear habitat
Assessment of mortality risk	mortality risk estimated by correlating the number and distribution of killed bears with road networks, settlement/industrial areas, and backcountry recreation activity areas.	Increased grizzly bear mortality risk is associated with public roads, human settlements, and backcountry infrastructure	Mortality risk considered high if there are: • specific areas of concentrated grizzly bear kills • >30% of kills were female • human-caused mortality exceeds 4%

4.3 IMPACTS

4.3.1 Grizzly Bear Habitat

4.3.1.1 Indicator Results

The following table presents area analysis results for the following.

- Area of grizzly bear terrestrial habitat representation in the GLB and THLB by capability class and scenario
- Percentage of the grizzly bear terrestrial habitat capability in current or proposed protection areas by capability class and scenario

Table 4-2: Grizzly bear terrestrial habitat indicator results

Indicator	Total amount in plan area (ha)	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Class I habitat capability in the GLB	23,648	11%	44%
Class I habitat capability in the THLB	4,435	0%	27%
Class II habitat capability in the GLB	141,571	5%	41%
Class II habitat capability in the THLB	18,473	0%	37%
Incremental number of virtual grizzlies protected		15	132
Cumulative frequency of bears protected		7%	61%

Source: MSRM

4.3.1.2 Indicator Results Discussion

➢ There is a substantial increase in the proportion of GLB and THLB area with high capability terrestrial grizzly bear habitat in protection areas under the LRMP Scenario compared to the Baseline Scenario.

- The coarse-filter biodiversity GMD[14] mid-seral target which limits the amount of mid-seral forests to a maximum of 17% by site series by BEC variant applies as the target to maintain landscape-level forage supply for grizzly bears in the Kitsault and Paril watersheds. Other identified watersheds are to be managed using an adaptive management approach to maintain landscape-level forage supply. Through LRMP implementation, risk to grizzly bear forage supply should be mitigated by:

  - The representation of landscape-level forage supply in protection areas.
  - Maintaining natural distributions of mid-seral stages in key grizzly bear identified watersheds and LUs where risks are highest (e.g. Big Falls, Somerville LUs).
  - Managing for productive understories in the THLB using strategies such as pre-commercial thinning, group selection, selection harvesting, variable retention, and reduced stocking densities.

- Other GMD targets to minimize mortality risk and habitat displacement as a result of road development and human use (including hunting, poaching, tourism and recreation use) require the implementation of strategies to minimize or mitigate impacts. These risks cannot be assessed in this analysis but can have large impacts on grizzly bear populations if they are not managed for.

- ***Baseline Scenario*** - Under the Baseline Scenario, the relative risk to grizzly bear terrestrial habitat capability is considered low across the entire LRMP plan area, although moderate to high in specific landscape units and watersheds [Hamilton and Horn 2003]. Class 1 and class 2 grizzly bear terrestrial habitat capability is not well represented in protection areas in the GLB, and no protection areas occur in the THLB. The number of estimated bears in protection areas is 15 or 7% of the population. These bears are found almost entirely in the Khutzeymateen Grizzly Bear Sanctuary, which encompasses 44,902 ha of the NC plan area.

- ***LRMP Scenario*** - Under the LRMP Scenario, protection of class 1 terrestrial habitat capability is approximately four times greater than the Baseline Scenario with 44% potentially included in protection areas. 27% of the class 1 grizzly bear terrestrial habitat capability in the THLB is in proposed protection areas under this scenario. For class 2 habitat, protection increases to 41% in the GLB and 37% of the THLB. Under this level of protection, an estimated 132 bears or 61% of the population are in protection areas. Incremental to currently existing protection areas, additional high capability grizzly bear habitat protected includes (but is not limited to):

[14] GMD targets have not yet been negotiated at the Table so they are subject to change.

- Kshwan – Productive estuary with excellent grizzly bear habitat including very high salmon abundance. Potentially at high risk due to recreation and tourism use that may result in habitat displacement and/habituation.
- Kwinamass – A large pristine watershed, adjacent to the Khutzeymateen with good connectivity between the two areas. Potentially at high risk of habitat displacement due to recreation and tourism use.
- Khyex – Contains high value grizzly bear habitat at moderate risk under the Baseline Scenario. A potential connected road network could result in high bear mortality risk if mitigative measures are not implemented.
- Quaal River – An area of high grizzly bear habitat suitability with high fisheries values, and an extensive floodplain and major estuary.
- Chambers East – Contains critical grizzly bear habitat at moderate risk under the Baseline Scenario as most of the floodplain is already impacted.

4.4 CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests there is reduced risk to grizzly bears compared to the Baseline Scenario.

The additional protection areas in the Kwinamass and Khyex LUs adjacent to the already existing Khutzeymateen Grizzly Bear Sanctuary will maintain a large area of contiguous high value grizzly bear habitat capable of supporting high bear densities. Generally, risk to grizzly bears across the plan area is low as a result of LRMP implementation. However, specific watersheds (concentrated in specific LUs) were identified as moderate to high risk under the Baseline Scenario (e.g. Kitsault, Somerville, Big Falls LUs). Therefore, mitigative measures could be required to lower the risk in identified LUs that are not likely to be included as protection areas (e.g. Kitsault, Somerville, Chamber West, Big Falls) as well as LUs not considered for protection at all (Bishop, Kitkiata, Scotia).

Re GMD impacts, Reid concludes "GMD proposes making reserves for 100% of class 1 habitat and 50% of class 2 habitat. This would substantially reduce risk in LUs without protection. Without this GMD the value of many of the protection areas is reduced because of lack of buffering for bears with large home ranges." [April 2004]

There are two important concerns regarding grizzly bears that were not addressed in this analysis.

- First, the status and welfare of coastal bears is very closely tied to productive salmon runs. Therefore, increased risk to salmon translates into increased risk for grizzly bears, which should be an important consideration in grizzly bear management.
- Second, this analysis did not address potential increased human use, i.e. tourism and recreation user days that can also have negative impacts on grizzlies through habitat displacement or increased mortality risk. Therefore, recreational activities need to be managed with this in mind.

The following are the summary assessments about the overall risk of the LRMP scenarios on grizzly bears.

- Baseline Scenario – low risk

- LRMP Scenario – very low risk

5. MOUNTAIN GOAT

5.1 BACKGROUND

The Mountain Goat is an important consideration in land-use planning for a number of reasons [Pollard 2003a]:

- Mountain goats occur in every biogeoclimatic zone and ecosection in the NC LRMP; however, the highest densities occur in the Kitimat Ranges Ecosection, where extensive topographical relief and drier winter weather generally provide higher quality habitat.
- While goats live in the alpine during much of the year, they are dependant on forest cover in the winter for forage, and for thermal and security cover. Mountain goat mortality is highest in the winter.
- There is limited availability of winter habitat in the landscape because goats require forest cover in close proximity to escape terrain (steep, rocky bluffs and cliffs) [Fox et al. 1989].
- Habitat alteration (e.g. forest harvesting) can have negative consequences to goat populations by removing forest cover. Further, goat populations show high site fidelity meaning they will not readily move to a new area if their habitat has been impacted.
- Increased human access as a result of road and industrial development, recreational use, and helicopter activity can negatively impact goat populations through increased physiological stress, increased hunting and poaching, and possibly increased predation risk.
- British Columbia supports over half the global population of mountain goat populations and therefore has a high responsibility to maintain this species.

5.2 IMPACTS

5.2.1 Mountain Goat Range

5.2.1.1 Indicators

To investigate potential effects of alternative land-use management plans on mountain goat winter range in the NC plan area, three indicators were combined to assess the overall risk to mountain goats: forest cover, road density, and population stability by ecosection. They are presented and discussed in the following table.

Table 5-1: Mountain Goat ERA indicators

Indicator	Rationale	Evaluation of risk
forest cover	Goats use mature and old forests for forage and thermal cover in the winter [Smith 1986, Fox et al. 1989]	risk assessed by the degree of overlap between goat winter range habitat and the THLB as overlap increases, risk to winter range increases
road density within 300 m	Increased road density and access may increase mortality risk due to more frequent hunting and poaching, and due to displacement from good quality habitat	risk was assessed by the total km of road within 300 m of winter range (%) as the total km of road increased, mortality risk in winter range increased
population stability	Small, isolated populations are less resilient to demographic and environmental stochasticity	Subjective assessment of mountain goat population density and it's degree of isolation from other populations by ecosection Mountain goat populations with low densities and a high degree of isolation are at higher risk

5.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of mountain goat winter range habitat in the GLB and THLB by confidence level and scenario
- Percentage of mountain goat winter range habitat in current or proposed protection areas by confidence level and scenario

Table 5-2: Mountain goat winter range indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
High confidence winter range GLB area	18,987 ha	10%	37%
High confidence winter range THLB area	1,286 ha	0%	13%
Less confidence winter range GLB area	47,036 ha	5%	42%
Less confidence winter range THLB area	2,273 ha	0%	23%

Source: MSRM

5.2.1.3 Indicator Results Discussion

➢ There are substantial increases in the proportion of GLB and THLB area with high value mountain goat winter range habitat under protection under the LRMP Scenario compared to the Baseline Scenario.

- The target for the GMD of mountain goat winter range tentatively agreed to by the NC LRMP Table in mid-March 2004 is 90% retention of unmodified mature/old forest in

each winter range unit. This GMD target is based on individual winter range units that have been confirmed and their boundaries outlined. Maintaining mountain goat winter range will require on-going active management as winter ranges are confirmed. *However, given the limited area of mountain goat winter range in the THLB, management options that minimize harvesting in identified winter range may not be unduly constraining to timber production while still maintaining low risk to mountain goat winter range habitat.*

- Other specific GMD targets relate to mortality risk and habitat displacement as a result of road development and increased access; the area analysis cannot assess these risks. In addition to protection areas, other strategies are required to minimize or mitigate impacts of these factors in specific LUs with high quality mountain goat winter range habitat.

- ***Baseline Scenario*** - Under the Baseline Scenario, 10% of mountain goat winter range is represented in protection areas. The relative risk to mountain goat winter range is considered low or very low in most LUs, with only two LUs (i.e. Kitsault and Pa_aat) at moderate risk [Pollard 2003a].

- ***LRMP Scenario*** - The LRMP Scenario would result in almost four times the area of mountain goat winter range in protection areas (37%) compared to the Baseline Scenario. Qualitative assessment of increased protection afforded under the LRMP Scenario suggests a continued reduction in risk to mountain goats compared to the Baseline Scenario with four LUs showing a decrease in one risk category. This includes three LUs (i.e. Chambers, Brown, and Johnston) moving from low to very low risk, and the Pa_aat LU reduced to low from moderate risk. The actual risk would also likely decrease in several other LUs although these do not register because the reduction remains within the original very low or low risk categories. Incremental to currently existing protection areas, proposed protection areas with confirmed high value mountain goat winter range include (but are not limited to): Kshwan, Olh North, Kwinamass, and Chambers East.

5.3 CONCLUSIONS

Overall, the increase in protection areas with the implementation of LRMP Scenario suggests there is reduced risk to mountain goat winter range compared to the Baseline Scenario as several confirmed high value winter range units occur in proposed protection areas.

Generally, risk to mountain goats across the plan area is low as a result of LRMP implementation. However, winter range in two specific LUs, i.e. Kitsault and Pa_aat, that are not included in proposed protection areas were identified at moderate risk under the Baseline Scenario. Therefore, mitigative measures may be required to lower the risk to mountain goats in these two LUs if they are not included in protection areas.

Re the GMD impact, Reid concludes “GMD proposes reserves for 90-100% of each individual winter range. As long as this includes protection for the mature forest component of the winter range, the risk to winter range will be very low.” [April 2004]

As one caveat of this analysis, mortality risk associated with roads and human use could not be assessed based on the area analysis. These factors can modify risk to mountain goats up if they are not regulated.

The following are the summary assessments about the overall risk of the LRMP scenarios on mountain goats.

- Baseline Scenario – low risk
- LRMP Scenario – very low risk

6. MARBLED MURRELET

6.1 BACKGROUND

The Marbled Murrelet is an important consideration in North Coast land and resource planning for the following reasons [Steventon 2003]:

- Marbled murrelets, a small, secretive seabird, spends much of its life at sea but nests on large, mossy limbs of mature and old-growth forests, usually within 30 km, and not more than 80 km from the ocean.
- The NC LRMP area provides nesting habitat for approximately 15-20% of British Columbia's Marbled Murrelet population, indicating there is a relatively high regional responsibility to maintain this species.
- In the NC LRMP plan area, the highest densities tend to occur in LUs that border the shoreline (e.g. Banks, Chambers, Kaien, Bishop, Kitkiata), and decrease further inland.
- The Marbled Murrelet is threatened in Canada and red-listed in British Columbia. The "threatened" species designation is not due to low population numbers but rather due a decline in nesting habitat and a perceived decline in population abundance. The NC LRMP process provides a unique opportunity to prevent further decline in a relatively abundant listed species.
- Industrial forestry operations are a potential threat to the viability of murrelet populations through the loss of nesting habitat, and increased predation risk.
- Marbled Murrelets are designated as an "identified wildlife species" as part the British Columbia's Identified Wildlife Management Strategy (IWMS) [IWMS 2004]
- The NC LRMP planning area, in conjunction with coastal regions of the Kalum district, is one of six murrelet conservation regions proposed by the Canadian Marbled Murrelet Recovery Team (CMMRT) whose main goals are to de-list (i.e. remove it from the threatened list) the Marbled Murrelet federally and maintain its current range.

6.2 IMPACTS

6.2.1 Marbled Murrelet Nesting and Population

6.2.1.1 Indicators

To investigate potential effects of alternative land-use management plans on Marbled Murrelet populations in the NC plan area, the NC Landscape Model results [Steventon 2003] and area-analysis results were combined to assess risk to Marbled Murrelet populations. Two indicators of murrelet populations were analyzed in the NC Landscape Model to determine risk to Marbled Murrelets under the Baseline Scenario [Steventon 2003]: nesting carrying capacity and risk to population persistence. These are presented and discussed in the following table.

Table 6-1: Marbled Murrelet ERA indicators

Indicator	Rationale	Evaluation of risk
Nesting carrying capacity	Declines in area of suitable nesting habitat may result in fewer reproducing adults, fewer new animals entering the population, and ultimately, a decline in population size [Cam et al. 2003]	Risk was assessed based on a decline in nesting habitat capacity compared to current capacity As nesting capacity declines, the risk to Marbled Murrelet populations increases
Risk[15] to population persistence	Population-level estimates of survival and/or reproduction provide the least ambiguous information as to the status of animal populations	The risk to population persistence model incorporates both at-sea and terrestrial factors affecting populations including survival rates, reproductive rates, and nesting capacity Increasing risk to a murrelet population represents a decline in population resilience to disturbances

6.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of Marbled Murrelet most likely + moderately likely nesting habitat in the GLB and THLB by distance from the ocean and scenario
- Percentage of Marbled Murrelet most likely + moderately likely nesting habitat in current or proposed protection areas by distance from the ocean and scenario

Table 6-2: Marbled Murrelet indicator results

Indicator	Total amount in plan area ha	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Most + Moderately Likely Mamu habitat GLB area 0 to 30 km from coast line	**460,827**	3%	28%
Most + Moderately Likely Mamu habitat THLB area 0 to 30 km from coast line	**97,773**	0%	25%
Most + Moderately Likely MAMU habitat GLB area 31 to 50 km from coast line	**6,251**	0%	24%
Most + Moderately Likely MAMU habitat THLB area 31 to 50 km from coast line	**2,192**	0%	16%

Source: MSRM

6.2.1.3 Indicator Results Discussion

➢ There is a considerable increase in the proportion of GLB and THLB area with Marbled Murrelet habitat under protection under the LRMP Scenario compared to the Baseline Scenario.

- The GMD for Marbled Murrelets includes an objective to maintain the quantity and quality of nesting habitat across the plan area, and in core areas or sub-zones of the plan

[15] Steventon (2003) emphasized "risk" to population persistence is not a literal prediction of population extirpation from the plan area but rather a relative measure of the resiliency of murrelet populations

area. This would entail establishing a percentage of 2002 functional nesting habitat as a target in each of these areas. While targets have not been negotiated or agreed to by the LRMP Table, the Marbled Murrelet Recovery Team recommends a minimum of 69% of functional nesting habitat to be maintained across the plan area in order to de-list Marbled Murrelets. Another GMD target is to ensure population declines of Marbled Murrelets do not exceed 31% over 30 years.

- ***Baseline Scenario*** - Under the Baseline Scenario, only 3% of suitable nesting habitat is located in protection areas and none of this occurs in the THLB. A moderate decline (27-45%) in Marbled Murrelet nesting capacity is expected in 200 years compared to current estimated levels; this translates into a low to moderate risk to Marbled Murrelet populations [Steventon 2003]. However, risk to population persistence is not expected to increase as a result of reduced nesting capacity.

- ***LRMP Scenario*** - There is a substantial increase in the level of suitable habitat that is in protection areas under the LRMP Scenario including 28% of Marbled Murrelet habitat in the GLB and 25% in the THLB. Incremental to existing protection areas in the NC plan area, protection areas proposed under the LRMP Scenario with high value Marbled Murrelet habitat include (but are not limited to): Kwinamass, Monckton, Simpson Lake, and Quall.

6.3 CONCLUSIONS

Under the LRMP Scenario, approximately one quarter of suitable nesting habitat is represented in protection areas compared to only 3% in the Baseline Scenario. Therefore, the LRMP Scenario should lessen the risk to population nesting capacity as nesting habitat in protection areas cannot be diluted due to industrial development.

The risk levels summarized below are subject to some caveats. Risk to Marbled Murrelet could not be fully assessed by the area analysis alone because management outside protection areas will determine how well GMD targets can be met plan-wide or within zones. The quality of the habitat outside protection areas will likely decrease faster in a high protection scenario than in the baseline because old growth forests are generally targeted first for harvesting. Further, the area statistics do not provide enough information to determine whether any protection areas can act as a core population. Careful management will still be required across the landbase outside protection areas using strategies such as old-growth retention areas, wildlife tree patches, and riparian reserves on high quality nesting habitat, to mitigate risk to Marbled Murrelets.

Re the GMD impact, Reid concludes “GMD for ecosystem representation, hydroriparian reserves, red and blue listed ecosystems, grizzly bear critical habitat reserves and even mountain goat winter range reserves would further reduce risk to nesting capacity (but not less than low). This effect can be maximized by making such reserves as large as possible, rather than as smaller fragments.” [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on Marbled Murrelets.

- Baseline Scenario – low-moderate risk

- LRMP Scenario – low risk

7. BLACK BEARS

7.1 BACKGROUND

Black bears are an important consideration in North Coast land and resource planning for the following reasons [MSRM 2003]:

- Black bears are widespread throughout the NC LRMP plan area with the exception of the outer coast and some islands. While there are no accurate estimates of North Coast black bear population size, density or trends, the species is not considered at risk; density is estimated as being between 200 to 500 bears per 1,000 km^2.
- Similar to grizzly bears, black bears are dependent on the seasonal availability of a wide variety of habitats to meet life requisites.
- Black bears have high social value because they are a big game species, they provide opportunities for ecotourism wildlife viewing, and they are a symbol of coastal rainforests, particularly the Kermode bear, the white-phase of the black bear subspecies on the coast.
- Planning issues related to black bears are similar to grizzly bears including: minimizing mortality risk associated with human food, garbage and open road networks; protecting critical denning, security, and foraging habitats; minimizing habitat displacement or habituation due to human activities; minimizing potential human-induced disruption in the frequency of the gene responsible for the white phase Kermode bears.

7.2 IMPACTS

7.2.1 Black Bear Habitat

7.2.1.1 Indicators

To investigate potential effects of alternative land-use scenarios on black bears, percent area of black bear habitat ranked from nil to very high quality habitat in protection areas was analyzed.

7.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of black bear habitat in the GLB and THLB by suitability of habitat (i.e. nil to very high) and scenario
- Percentage of black bear habitat in current or proposed protection areas by suitability of habitat (i.e. nil to very high) and scenario

Table: 7-1: Black bear indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Very High GLB	403,357 ha	3%	41%
Very High THLB	37,768 ha	0%	30%
High GLB	509,986 ha	1%	21%
High THLB	43,099 ha	0%	13%
Moderate GLB	699,855 ha	5%	42%
Moderate THLB	47,057 ha	0%	22%
Low GLB	51,860 ha	0%	35%
Low THLB	884 ha	0%	4%
Very Low GLB	3,951 ha	0%	0%
Very Low THLB	0 ha	0%	0%

7.2.1.3 Indicator Results Discussion

➢ There is a substantial increase in the proportion of GLB and THLB area of moderate to high suitability black bear habitat under protection via the LRMP Scenario compared to the Baseline Scenario.

- The GMD targets related to black bear habitat are tied in with other environmental values such as coarse-filter biodiversity, grizzly bears, and aquatic/riparian ecosystems. Management considerations include: maintaining adequate forage habitat, denning habitat and the integrity of critical habitats.

- Other specific GMD targets relate to minimizing mortality risk and bear habitat displacement or habituation as a result of motorized vehicle access and human disturbance. To maintain a high proportion of white-phase bears on some islands, special management options may be required to minimize human influences that can potentially disrupt the white coat colour gene frequency.

- ***Baseline Scenario*** - High and very high suitability habitat is underrepresented in protection areas at 3% and 1% respectively under the Baseline Scenario. There is no high suitability black bear habitat in THLB protection area.

- ***LRMP Scenario*** - Under the LRMP Scenario, there is a substantial increase in the amount of high and very high suitability habitat in protection areas in the NC LRMP area compared to the Baseline Scenario. Very high suitability habitat increases to 41% and 30% in the GLB and THLB, respectively. High suitability habitat increases to 21% and 13% in the GLB and THLB, respectively. Incremental to existing protection areas, proposed protection areas with high value black bear habitat include (but are not limited to): Kshwan, Kwinamass, Khyex, and Johnston.

7.3 CONCLUSIONS

The area analysis indicates risk to black bear habitat is significantly reduced under the LRMP Scenario compared to the Baseline Scenario due to the reduction of black bear habitat in the general management zone.

Kiltuish River, Gribbell Island, Gil Island, and Hawkesbury Island are areas identified [Marshall and Ritland 2002] with high incidence of white-phase Kermode bears but are not included in proposed protection areas. Black bears in these areas are therefore at the same potential risk as under the Baseline Scenario and therefore may require special management consideration.

Generally, with planning considerations for representation of old-forest ecosystems, seral stage distribution, and productive understories, the risk to black bear habitat will be minimized under the LRMP Scenario. However, there are three important concerns regarding black bears that were not addressed in this area analysis. First, it is important to manage for critical black bear habitat that is not addressed by GMD targets for other environmental values. Second, even if black bear habitat is protected, there is still a risk to black bears and particularly the Kermode if human-use and tourism are not appropriately regulated. Finally, any increase in risk to salmon populations will also results in an increased risk to black bear populations because of its importance in their diet.

Re the GMD impact, Reid concludes "Proposed GMDs that would keep risk very low include stand-level retention of old-forest structure in WTPs (for dens), and limits to mid-seral representation at the watershed and landscape scales along with reduced stocking densities for regeneration (to maintain forage availability through a rotation). These GMDs are essential for maintaining risk at low levels, especially with small island populations." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on black bear habitat.

- Baseline Scenario – low risk
- LRMP Scenario – very low risk

8. MOOSE

8.1 BACKGROUND

Moose are an important consideration in North Coast land and resource management planning for several reasons [Pollard 2003b]:

- Moose are present in most North Coast drainages and its range continues to expand.
- Moose is a yellow-listed species and, while populations are not threatened, it has high social and economic value as a big game species, sustenance food resource, and subject for ecotourism wildlife viewing.
- Winter forage and cover habitat requirements are the primary management concerns for moose. Mature/old forests with good snow interception, adjacent to areas of extensive shrub growth, are the preferred habitat combination as these provide bedding sites and thermal cover, and facilitate movement to foraging opportunities.
- Mortality risk to moose may increase with road development due to increased legal but unregulated hunting, poaching, vehicle collisions, and habitat displacement.

8.2 IMPACTS

8.2.1 Moose Winter Habitat

8.2.1.1 Indicators

For the area analysis, moose winter habitat was divided into two categories [Pollard 2003b] as follows:

- primary winter range habitat – permanent habitats that provide a continual source of shrub forage as a result of regular disturbances (e.g. riparian areas of major rivers flooded annually, and avalanche chutes).
- secondary winter range habitat – transient habitats that provide a temporary shrub resource before succeeding into older plant community types (e.g. early seral stages as a result of forest harvesting or wind-throw). Secondary winter habitat can be further subdivided into type A, which does not contain persistent forage communities, and type B, which does contain persistent communities but of reduced value due to other limiting factors such as snow depth, poor connectivity or small area [Pollard 2003b].

8.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of moose winter range habitat in the GLB and THLB by suitability of habitat (i.e. primary and secondary) and scenario
- Percentage of moose winter range habitat in current or proposed protection areas by suitability of habitat (i.e. primary and secondary) and scenario

Table 8-1: Moose winter range indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Primary winter range GLB area	19,686 ha	11%	67%
Primary winter range THLB area	5,440 ha	0%	63%
Secondary winter range GLB area	15,649 ha	2%	42%
Secondary winter range THLB area	5,208 ha	0%	34%

8.2.1.3 Indicator Results Discussion

➢ There is a substantial increase in the proportion of GLB and THLB area of primary and secondary moose winter range habitat under protection under the LRMP Scenario compared to the Baseline Scenario.

- The NC GMD for moose includes an objective to maintain the quality of snow interception and browse production in identified moose winter range. Other specific GMD targets relate to minimizing mortality risk as a result of roads in identified moose winter range.

- ***Baseline Scenario*** - Approximately 13% of primary and secondary moose winter range habitat is in current protection areas but none of this protection occurs in the THLB. Of 33 identified moose winter range units, 23 units are considered to be at very low risk and 10 units at low risk [Pollard 2003b].

- ***LRMP Scenario*** - A substantial increase in moose winter range protection occurs under LRMP Scenario with 67% of primary habitat and 42% of secondary habitat protected; 63% and 34% of primary and secondary habitat occurring in the THLB is protected. Incremental to existing protection areas, proposed protection areas with confirmed high value moose winter range include (but are not limited to): Kshwan, Kwinamass, Khyex, Khtada, Johnston, and Chambers.

8.3 CONCLUSIONS

Overall, the increased protection of primary and secondary moose winter range with the implementation of the LRMP Scenario suggests risk to moose winter range is very low compared to the Baseline Scenario.

Moose populations are already considered at low risk in all winter range units and moose populations are expected to increase in the future. Therefore, it is highly unlikely that moose will be negatively impacted by the implementation of the LRMP Scenario.

Re the GMD impact, Reid concludes "Proposed GMD … would further reduce risk to very low in winter range units outside protection areas by developing access controls on some public-access forest service roads." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on moose winter range.

- Baseline Scenario – low risk
- LRMP Scenario – very low risk

9. TAILED FROG

9.1 BACKGROUND

Tailed frogs (*Ascaphus truei*) are an important consideration in North Coast management planning for several reasons as follows:

- Tailed frogs in the NC LRMP are at the northern tip of their range [Dupuis et al. 2000].
- This species is blue-listed in BC and is designated as an "identified wildlife management species" [IWMS 2004].
- Tailed frogs are adapted to cool, fast-flowing, permanent mountain streams with cobble-sized substrate as preferred microhabitat.
- Both juveniles and adults are physiologically restricted to cool, moist microclimates typically found in closed canopy forest, which are evident on the North Coast.
- Tailed frogs are sensitive to land-use practices at several spatial scales. Disturbances at the watershed, sub-basin, and stand-level can impact in-stream habitat characteristics and riparian forest microclimatic conditions. Specific concerns include: increased sedimentation and destabilization of in-stream habitat, and the removal of forest canopy cover.
- Tailed frogs typically occur in small streams (i.e. S4-S6) that are afforded little protection by the Forest and Range Practices Act

9.2 IMPACTS

9.2.1 Tailed Frog Stream Habitat

9.2.1.1 Indicators

To investigate potential effects of alternative land-use management plans on tailed frogs, the percent length (km) of optimal tailed frog stream habitat in protection areas was analyzed.

9.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Stream length (km) of optimal tailed frog habitat in the GLB and THLB by scenario
- Percent stream length of optimal tailed frog habitat in current or proposed protection areas by scenario

Table: 9-1: Tailed frog indicator results

Indicator	Total amount in plan area (km)	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Optimum habitat - GLB	106 km	0%	26%
Optimum habitat - THLB	38 km	0%	22%

Source: MSRM

9.2.1.3 Indicator Results Discussion

➢ There is a considerable increase in the percentage stream length of optimal tailed frog habitat under protection in the GLB and THLB under the LRMP Scenario compared to the Baseline Scenario.

- The draft North Coast general management direction for tailed frogs is to maintain in-stream habitat quality. The risk avoidance target for tailed frogs is to maintain their in-stream habitat in an 100% unmodified condition. The level of protection under LRMP Scenario does not approach this target. Therefore, management options that minimize impacts to tailed frog habitat outside Protection Areas will be required to mitigate risk to their habitat.

- ***Baseline Scenario*** - Under the Baseline scenario, no optimal tailed frog habitat is represented in protection areas.

- ***LRMP Scenario*** - The implementation of LRMP Scenario results in a relatively large increase in tailed frog optimal habitat in protection areas, including 26% of GLB habitat, and 22% of THLB habitat.

9.3 CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests there is reduced risk to tailed frog stream habitat compared to the Baseline Scenario.

While only 22% of their habitat in the THLB is included in protection areas, the relatively large percentage of stream length that is in the GLB increases the certainty that tailed frog in-stream habitat will be maintained. However, risk remains moderate to high because high quality aquatic habitat for tailed frogs receives no protection. Further, little is known about tailed frog terrestrial habitat requirements and the draft North Coast GMD does not address tailed frog terrestrial habitat. Therefore, mitigative measures may be required along tailed frog streams with high quality habitat to limit the risk to their in-stream habitat. The measures could include careful planning of roads, maintaining riparian buffers, and maintaining the connectivity of riparian ecosystems to other streams and to upland areas. The last two points may be particularly important to consider as these efforts likely maintain terrestrial tailed frog habitat as well.

Re the GMD impact, Reid concludes "Proposed aquatic and riparian GMD …could reduce risk to low by applying protective riparian reserves to frog streams, and by minimizing sedimentation. However, the terrestrial habitat requirements of tailed frogs are poorly understood. Substantial

risk reduction is contingent on better science regarding habitat needs, and accurate operational inventories to identify frog streams." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on tailed frogs.

- Baseline Scenario – high risk
- LRMP Scenario – Low-moderate risk

10. NORTHERN GOSHAWK

10.1 BACKGROUND

The Northern Goshawk (*Accipiter gentilis*) is an important consideration in North Coast land and resource planning for the following reasons [Mahon et al. 2003]:

- The goshawk is a raven-sized forest raptor with well established nesting habitat requirements for: mature/old-growth stand structure with trees and branches large enough to support their nests, intermediate canopy closure (45% to 70%), open understory, and a possible preference for hemlock forests.
- Landscape-level foraging habitat requirements are not well known but goshawks may select mature/old-growth forests for foraging.
- Goshawks may be negatively affected by forest harvesting due to their association with mature/old forests.
- A.g. *laingi* is assumed to be the species occurring in the NC LRMP plan area; genetic work is required to corroborate this assumption. This sub-species is endangered, as well as being an "Identified Wildlife" species [IWMS 2004].
- Due to the goshawk's relatively large area requirements (up to 4,000 ha for nesting, post-fledging, and foraging), it might potentially function as an umbrella species in the NC LRMP plan area.

10.2 IMPACTS

10.2.1 Northern Goshawk Nesting Habitat

10.2.1.1 Indicators

To investigate potential effects of alternative land-use management plans on goshawks, percent area of high quality (Class 1) goshawk nesting habitat in protection areas was analyzed.

10.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of high quality goshawk habitat in the GLB and THLB by scenario
- Percentage of high quality goshawk habitat in current or proposed protection areas by scenario

Table 10-1: Northern goshawk indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Class 1 habitat GLB area	119,299 ha	4%	30%
Class 1 habitat THLB area	51,862 ha	0%	26%

Source: MSRM

10.2.1.3 Indicator Results Discussion

➢ There is a substantial increase in the proportion of GLB and THLB area with high quality goshawk habitat under protection via the LRMP Scenario compared to the Baseline Scenario.

- The draft North Coast GMD target for goshawks is to maintain all known goshawk nest areas and post-fledging areas using the Identified Wildlife Management Strategy (IWMS) objectives as a guide. IWMS objectives include maintaining all known goshawk nest areas and post-fledging areas with sufficient mature and old forest to allow continued occupancy and successful reproduction in a 200 ha nest and post-fledging area. The IWMS also requires maintaining sufficient foraging habitat in a 2,200 ha area surrounding the nest area to allow continued occupation of a breeding territory. To meet goshawk GMD targets on-going active management will be required as nests are discovered.

- ***Baseline Scenario*** - Currently, high quality goshawk habitat has limited representation (~4%) in current protection areas.

- ***LRMP Scenario*** - There is a 20% increase in the level of goshawk habitat protection under LRMP Scenario, compared to the Baseline in the GLB as well as in the THLB alone. Incremental to existing protection areas, protection areas proposed in the LRMP Scenario with high value goshawk habitat include (but are not limited to): Chambers East and Khtada West.

10.3 CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests there is reduced risk to high quality goshawk habitat compared to the Baseline Scenario.

Currently few nest areas have been discovered in the NC plan area and therefore, the draft GMD targets of maintaining nesting and foraging habitat can only be met as new information becomes available (i.e. new nests are discovered). The goshawk habitat located in protection areas will help mitigate risk to populations as protection areas will likely conserve full goshawk territories (including nesting and foraging habitat). In addition, these areas will not have to be inventoried for goshawk nesting habitat. However, a relatively substantial percentage of the THLB (41%) is high quality goshawk nesting habitat and therefore, active management of goshawk habitat will likely be required in the THLB, through approaches such as old-growth management areas, wildlife tree patches, and variable retention strategies, to maintain the mature/old-growth structural stages used as habitat by goshawks and mitigate risk to their populations.

Re the GMD impact, Reid concludes "Proposed GMD includes establishment of nest and post-fledging area old-growth reserves, and maintenance of sufficient old-growth foraging habitat through reserves (e.g., hydroriparian) and WTP retention. Dedicated application of this GMD, based on research to identify what is sufficient foraging habitat, will reduce risk to low or very low." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on northern goshawks.

- Baseline Scenario – high risk
- LRMP Scenario – low risk

11. AQUATIC AND RIPARIAN

11.1 BACKGROUND

Hydroriparian areas are an important consideration in North Coast land and resource planning for the following reasons:

- Although spatially restricted in the NC LRMP area, aquatic and riparian (hydroriparian) areas are dynamic ecosystems characterized by high structural complexity and high species richness [Price 2003].
- Intact riparian zones serve a number of ecological functions by providing shade, bank stability, nutrients, allochthonous input, and woody debris; all serve to protect water quality and maintain stream channel morphology [Liepins 2003].
- As an ecotone between aquatic and upland ecosystems, terrestrial riparian areas have a unique microclimate, higher productivity (e.g., greater vegetation growth), and increased moisture compared to other terrestrial communities. These environmental conditions result in structurally complex and diverse vegetation communities providing important habitat for forest-dwelling vertebrates and invertebrates [Bunnell et al. 1999]
- A large number of vertebrate and invertebrate species occurring in the North Coast are obligate or facultative users of hydroriparian zones, including a number of economically important salmon species [Liepins 2003].

11.2 IMPACTS

11.2.1 Hydroriparian Ecosystems

11.2.1.1 Indicators

To investigate potential effects of alternative land-use management plans on hydroriparian ecosystems, the percent area of lakes, floodplains and high quality salmon supporting ecosystems (high and very high abundance) were analyzed.

11.2.1.2 Indicator Results

The following table presents area analysis results for the following.

- Area of hydroriparian ecosystems in the GLB and THLB by scenario including: salmon supporting ecosystems, lakes, and floodplains
- Percentage of hydroriparian ecosystems in current or proposed protection areas by scenario including: salmon supporting ecosystems, lakes, and floodplains

Table 11-1: Aquatic and riparian indicator results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Salmon supporting ecosystems (High & VH abundance) GLB area	447,448 ha	3%	44%
Salmon supporting ecosystems (High & VH abundance) THLB area	37,605 ha	0%	35%
Lakes (ha surface area) GLB area	47,740 ha	1%	34%
Lakes (ha surface area) THLB area	20 ha	0%	24%
Floodplains (ha surface area) GLB area	14,411 ha	17%	76%
Floodplains (ha surface area) THLB area	3,987 ha	0%	71%

Source: MSRM

11.2.1.3 Indicator Results Discussion

➢ There is a substantial increase in the proportion of GLB and THLB area with lakes, floodplains and high value salmon supporting ecosystems in protection areas of the LRMP Scenario compared to the Baseline Scenario.

- The draft North Coast general management direction for hydroriparian ecosystems focuses on maintaining ecological function in and around aquatic habitats. The NC LRMP Table have tentatively agreed to maintaining 50 m buffer reserves for estuaries, floodplains, lakes, and wetlands. These reserves in combination with the level of protection under the LRMP Scenario floodplains and lakes should substantially reduce the risk to these ecosystems, but not as much for salmon supporting ecosystems. Substantial portions of high quality fish habitat and their small upstream drainages do not receive protection maintaining their Baseline Scenario risk level. Management options that minimize impacts to hydroriparian ecosystems, particularly to salmon supporting ecosystems, will be required to mitigate risk and maintain hydroriparian ecological functions and integrity.

- ***Baseline Scenario*** - Under the Baseline Scenario, floodplains is the only riparian ecosystem type receiving substantial protection (17%). Lakes and salmon supporting ecosystems are poorly represented in protection areas (1% and 3% respectively). None of the riparian ecosystems receive protection in the Baseline Scenario's THLB.

- ***LRMP Scenario*** - The implementation of the LRMP Scenario results in a large increase in the area of riparian ecosystems represented in protection areas, including 44% protection for salmon supporting ecosystems, 34% for lakes, and 76% for floodplain ecosystems. A minimum of 24% of the area of riparian ecosystems occurring in the THLB is included in protection areas with 71% of the floodplain area protected. Chambers East, Khyex, Kwinamaas, and Quaal River are proposed protection areas incremental to existing protection areas that possess high value hydroriparian ecosystems.

11.3 CONCLUSIONS

Overall, the increase in protection areas with the implementation of the LRMP Scenario suggests there is reduced risk to hydroriparian ecosystems compared to the Baseline Scenario, particularly for floodplains.

Generally, risk to hydroriparian ecosystems would be low as a result of the implementation of the LRMP Scenario. However, specific areas may be at higher risk and require special management consideration because of threatened fish stocks (e.g. Kitsault , Pa_aat River, and Union Lake) or high wildlife values (e.g. extensive floodplains of Skeena and Ecstall River, large wetland complexes). Mitigative measures may be required to lower the risk in specific areas that are not included in protection areas.

As a caveat to this area analysis, the salmon-supporting ecosystems were defined based on drainage area, and not on the size of the run. Therefore, the area analysis assesses potential impacts on watersheds but does not necessarily reflect the strength of salmon-runs. Further analyses would be required based on other indicators of salmon (e.g. length of low gradient stream, total salmon biomass present, or number of salmon species present) to adequately assess potential risk to salmon-supporting ecosystems as a result of LRMP implementation. This area analysis also does not consider risk to salmon as a result of fisheries (both commercial or recreational). Even with increased protection of salmon habitat, risk to salmon can increase substantially as a result of human use.

The following are the summary assessments about the overall risk of the LRMP scenarios on hydroriparian ecosystems.

- Baseline Scenario:
  - Salmon supporting ecosystems - high risk
  - Lakes – moderate risk
  - Floodplains – moderate risk

- LRMP Scenario:
  - Salmon supporting ecosystems – moderate risk[16]
  - Lakes – low risk
  - Floodplains – low risk

[16] Salmon-supporting ecosystems were conservatively assigned to moderate risk even with a high degree of protection under the LRMP Scenario because amount of basin area is not the best indicator of salmon-supporting ecosystems [S. Liepins, MSRM, pers. comm.], and therefore may not adequately represent fish value.

12. RARE AND THREATENED ECOSYSTEMS

12.1 BACKGROUND

There are three red-listed and 10 blue-listed ecosystems occurring in the NC LRMP plan area. Of these listed ecosystems, six old-growth floodplain and alluvial/colluvial forest ecosystems were analyzed for the NC LRMP planning process [Ronalds and McLennan 2002]. The ecosystems include three red-listed ecosystems as follows.

- Ss-Salmonberry - CWHvm1/09
- Ss-Lily of the valley - CWHvh2/08
- Trisetum - CWHvh2/09

And three blue-listed ecosystems as follows.

- BaSs-Devil's Club - CWHvm1,2/08
- CwSs-Devil's Club - CWHvh2/07
- Act-Red osier dogwood - CWHwm/06, CWHvm1/10, CWHws1,2/08

Twelve watersheds had significant components of red-listed floodplain forest ecosystems [Ronalds and McLennan 2002].

These rare and threatened ecosystems are an important consideration in North Coast land and resource planning for the following reasons [Ronalds and McLennan 2002]:

- These six ecosystems historically have been predominantly old-growth forest characterized by large structural elements and flora and fauna unique to old forest ecosystems.
- The listed ecosystems have historically been targeted for harvesting first because they are productive, valley-bottom forests producing large timber that is easily accessible; some have already been heavily impacted.
- Management time frames are not long enough to re-establish the large structural attributes characteristic of these old-forest ecosystems.
- These ecosystems are commonly associated with fisheries sensitive zones providing several important functions such as stabilizing streambanks, and providing sources of LWD (large woody debris) important in maintaining stream channel morphology and creating important fish habitat.
- The listed ecosystems also have high wildlife habitat value (particularly for cavity-nesting birds and bears), providing wildlife nesting, denning, and foraging sites.

Eleven of 60 LUs in the NC LRMP have some documented overlap between listed ecosystems and the THLB, averaging 6.24%. However this percentage drops to 1.95% if CWHvm1/08 is excluded from the analysis [Reid et al. 2003]. The site series, CWHvm1/08 was excluded in one analysis because it is more common than previously thought and could be conceivably down-listed.

12.2 IMPACTS

12.2.1 Rare and Endangered Ecosystems

12.2.1.1 Indicator Results

The following table presents area analysis results for the following.

- Area of rare and endangered ecosystems in the GLB and THLB by scenario
- Percentage of rare and endangered ecosystem area in current or proposed protection areas by scenario

Table 12-1: Rare and endangered ecosystem results

Indicator	Total amount in plan area	Scenarios	
		Baseline	LRMP
		% Share in Current and Proposed Protection Areas	
Red-listed GLB	835 ha	0%	60%
Red-listed THLB	440 ha	0%	63%
Blue-listed (all) GLB	3072 ha	0%	67%
Blue-listed (all) THLB	1695 ha	0%	73%
Blue listed (without CWHvm1 / 08) GLB	614ha	0%	22%
Blue listed (without CWHvm1 / 08) THLB	165 ha	0%	29%

Source: MSRM

12.2.1.2 Indicator Results Discussion

➢ There is a substantial increase in the proportion of red and blue-listed ecosystems in the GLB and THLB under protection through the LRMP Scenario compared to the Baseline Scenario.

- The NC LRMP Table has tentatively agreed to the GMD target of maintaining the spatial extent (i.e. 100% reserve) for red-listed ecosystems throughout the plan area. With 60% of their total area already in protection under the LRMP Scenario and their limited areal extent in the THLB, measures to mitigate development in the remaining area (e.g. old-growth management areas) should not be unduly constraining to forestry operations while still increasing the likelihood of maintaining the structural and functional integrity of these rare ecosystems.

- The NC LRMP Table have tentatively agreed to the GMD target of maintaining 70% reserves (i.e. 70% of the area of each blue-listed stand or polygon) of blue-listed ecosystems throughout the plan area.

- ***Baseline Scenario*** - Rare and endangered ecosystems are not represented in protection areas of the Baseline Scenario; their area occurs almost entirely in the general management zone.

- ***LRMP Scenario*** - Implementing the LRMP Scenario would result in a substantial increase in the representation of red-listed ecosystems in protection areas (60% representation in the GLB, and 63% of the THLB). A similar level of representation occurs for blue-listed ecosystems when all are included. However, if CWHvm1/08 is excluded, 22% of the overall area of blue-listed ecosystems is protected in the GLB, and 29% in THLB protection areas.

12.3 CONCLUSIONS

Under the Baseline Scenario, red and blue-listed ecosystems are not represented in protection areas. The implementation of the LRMP Scenario would result in a substantial improvement in the representation of listed ecosystems in protection areas, and a reduction in risk.

This is particularly important given that two blue-listed ecosystems (Act-Red osier dogwood and CwSs-Devil's club) were recommended for up listing to red due to their rarity in the NC plan area [Ronalds and McLennan 2002]. Given that GMD targets for red and blue-listed species have be tentatively agreed to over the plan area, risks to these ecosystems will be low with LRMP implementation.

Re the GMD impact, Reid concludes "…Proposed GMD would include at least 70% protection of each blue-listed ecosystem unit, other than CWHvm1/08. Hydroriparian reserves will assist this process. This would reduce risk to low or very low, given accurate operational-scale inventory. Proposed GMD does not address the relatively common CWHvm1/08. Hydroriparian reserves may cover a few occurrences. Its risk remains moderate until GMD can be developed." [April 2004]

The following are the summary assessments about the overall risk of the LRMP scenarios on red and blue-listed ecosystems (with the exception of CWHvm1 / 08).

- Baseline Scenario – high risk
- LRMP Scenario – very low risk

BIBLIOGRAPHY

Bryant, D, D. Nielsen, and L. Tangley (1997) *The last frontier forests: ecosystems and economies on the edge.* World Resources Institute. Washington, D.C.

Bunnell F.L., L.L. Kremsater, and E. Wind (1999) *Managing to sustain vertebrate richness in forests of the Pacific Northwest: relationships within stands.* Environmental Review 7:97-146.

Cam, E., L. Lougheed, R. Bradley, and F. Cooke (2003) *Demographic assessment of a marbled murrelet population from capture-recapture data.* Conservation Biology 17(4): 1118-1127.

CIT [Coast Information Team] (2003a) *Ecosystem-based management planning handbook.*

CIT [Coast Information Team] (2003b) *Ecosystem-based management framework*.

Crane Management Consultants (March 2004) *Socio-Economic and Environmental Assessment of Interim Scenarios developed by the North Coast LRMP Table as of April 2004 Volume I: Socio-Economic Assessment* [Final Draft]. Prepared for BC Ministry of Sustainable Resource Management.

Dorner, B., and C. Wong (2003) *Natural disturbance dynamics on the North Coast*. Report prepared for the North Coast LRMP Government Technical Team.

Dupuis, L., F. L. Bunnell, and P. A. Friele (2000) *Determinants of the Tailed Frog's range in British Columbia, Canada.* Northwest Science 74:109-115.

Fox, J.L., C.A. Smith, and J.W. Schoen (1989) *Relation between mountain goats and their habitat in southeastern Alaska.* USDA Forest Service General Technical Report. PNW-GTR-246

Franklin, J. F. (1993) *Preserving biodiversity: species, ecosystems, or landscapes?* Ecological Applications 3:202-205.

Hamilton, T. and H. Horn (2003) *Environmental risk assessment. Grizzly bears: benchmark scenario analysis.* Report prepared for the North Coast LRMP Government Technical Team.

Holt, R. F. (2001) *An ecosystem-based managing planning framework for the North Coast LRMP.* Report prepared for the North Coast LRMP Government Technical Team.

Holt, R. and G. Sutherland (2003) *Environmental Risk Assessment Base Case: Coarse Filter Biodiversity.* Report prepared for the North Coast LRMP Government Technical Team.

Holt, R. (March 2004) *Protected Areas Scenarios: Coarse Filter Implications.* Report prepared for BC Ministry of Sustainable Resource Management.

IWMS [Identified Wildlife Management Strategy] (2004) *Standards for managing identified wildlife.* Ministry of Water, Land, and Air Protection.

Liepins, S. (2003) *Background report: aquatic and riparian habitat and values in the North Coast.* Report prepared for the North Coast LRMP Government Technical Team.

Mahon, T., D. Morgan and F. Doyle (2003) *Northern Goshawk (Accipiter gentiles) Habitat in the North Coast Forest District: Foraging area and nest area habitat suitability models.* Report prepared for the North Coast LRMP Government Technical Team.

Marshall, H.D. and K. Ritland (2002) *Genetic diversity and differentiation of Kermode bear populations.* Molecular Ecology 11(4): 685-697

Maxcy, K. and Crane Management Consultants (March 2004) *Socio-Economic and Environmental Assessment of Interim Scenarios developed by the North Coast LRMP Table as of April 2004 Volume II: Environmental Risk Assessment* [Final Draft]. Prepared for BC Ministry of Sustainable Resource Management.

Morgan, D.G., D. Daust, and S.A. Fall. (2002) *North Coast Landscape Model. Decision support system: benchmark scenario.* Ministry of Sustainable Resource Management.

Ministry of Sustainable Resource Management (2001) *Socio-economic and environmental impact assessment for land and resource management planning in British Columbia.*

Ministry of Sustainable Resource Management (2003a) *Information circular: Black bears in the North Coast.*

Ministry of Sustainable Resource Management (2003b) *Tailed Frog (Ascaphus truei) habitat suitability model.* Ministry of Sustainable Resources Management.

NC LRMP GTT [North Coast LRMP Government Technical Team] (2003) *Protected areas: supporting information*. Unpublished report of the NC LRMP, Ministry of Sustainable Resource Management.

Noss, R.F. (1999) *Assessing and monitoring forest biodiversity: a suggested framework and indicators.* Forest Ecology and Management 115:135-146.

O'Neil, T. A., R.J. Steidl, W.D. Edge, and B. Csuti. (1995) *Using wildlife communities to improve vegetation classification for conserving biodiversity.* Conservation Biology 9:1482-1491.

Pollard, B.T. (2003a) *Mountain goat winter range mapping for the North Coast Forest District.* Report prepared for the North Coast LRMP Government Technical Team.

Pollard, B.T. (2003b) *Environmental assessment: moose.* Report prepared for the North Coast LRMP Government Technical Team.

Price, K. (2003) *Hydroriparian planning guide.* Report prepared for Coast Information Team.

Reid, D. (April 2004) *Synopsis of risks to environmental values resulting from decisions at the NC LRMP Meeting March 26-28, 2004.* BC Ministry of Sustainable Resource Management.

Reid, D.G., K. Bush, T. Sheng, D. Morgan, L. Bolster, J. Warrens (2003) *Decision support system: static experiments.* Report to the North Coast LRMP Government Technical Team.

Ronalds, I. and D.McLennan (2002) *Terrestrial ecosystem mapping of the CDC-listed Ecosystems in the North Coast LRMP area.* Report to the NC LRMP Government Technical Team.

Simberloff, D. (1998) *Flagships, umbrellas, and keystones: is single-species management passe in the landscape era?* Biological Conservation 83:247-257.

Smith, C. A. (1986) *Bi-level analysis of habitat selection by mountain goats in coastal Alaska.* Proc. Bien. Symp North. Wild Sheep and Goat Council. 5:366-380.

Steventon, J.D. (2003) *Environmental Risk Assessment: Base Line Scenario – Marbled Murrelets.* Report prepared for the North Coast LRMP Government Technical Team.

APPENDIX I - EXPLANATION OF RISK

Coarse-filter biodiversity

The "range of natural variablity" (RONV) concept was used to calculate the base risk to coarse-filter biodiversity. The RONV describes the natural variability of disturbances for each ecosystem.

Specifically in the NC LRMP plan area, the RONV predicts the amount of old forest expected for each ecosystem. The main assumption of RONV is that as the difference between the managed landbase and natural landbase increases, risk to coarse-filter biodiversity also increases, i.e. biodiversity is more likely to be maintained if management practices resemble natural disturbance patterns. Based on this predicted old forest abundance, the divergence from the predicted amount was used to analyze risk to coarse-filter biodiversity with risk classified into five equal risk categories (see Table A1 below).

For example, the old forest ecosystem Cedar/Hemlock high AU was expected to have between 83% and 93% as old forest [Holt and Sutherland 2003]. However, the current amount of Cedar/Hemlock high is 10%. Therefore, there is a difference of at least 73% between the amount of old Cedar/Hemlock high that is expected compared to what currently exists, indicating this old forest ecosystem, and thus biodiversity within this ecosystem, is at high risk (60-80% deviation from predicted old forest abundance). This base risk for coarse-filter biodiversity can be modified up or down for each old forest ecosystem depending on the number of large, forest patches in each ecosystem, the amount in protection areas, and it's ecosystem conservation value.

Table A1: Risk categories for coarse-filter biodiversity indicators

Deviation from mean predicted old forest abundance	0-20%	20-40%	40-60%	60-80%	80-100%
Risk class	very low	low	moderate	high	very high

Marbled Murrelet risk classes

Two indicators were used to assess risk to marbled murrelets: nesting carrying capacity (i.e. estimated number of pairs a habitat can support) and long-term population persistence. Risk to nesting carrying capacity was assessed by comparing the current estimated nesting carrying capacity to future nesting carrying capacity [Steventon 2003]. As nesting carrying capacity declines relative to current capacity, risk to marbled murrelets increases as fewer birds can be supported by the habitat. Similar to coarse-filter biodiversity, five risk classes were used (see Table A2 below). Therefore, a 30% decline in nesting carrying capacity translates into low risk to marbled murrelets.

Table A2: Risk categories for marbled murrelet indicators

Decline in nest carrying capacity or Probability of population persistence	0-20%	20-40%	40-60%	60-80%	80-100%
Risk class	very low	low	moderate	high	very high

The probability of long-term population persistence was also assessed using five risk categories (Table A2). Persistence risk was defined as the percentage of simulated populations that stayed above 50 nesting females beyond a time frame of either 100 years or 300 years [Steventon 2003].

In terms of risk, if 70% of the simulated populations stay above 50 nesting females, this translates into a low probability (20-40%) of not persisting.

Mountain Goat

Risk to mountain goat populations was assessed using the same five categories as coarse-filter biodiversity and marbled murrelets (see Table A3 below). Under the very low risk category, mountain goat populations are more likely to be stable and/or increasing, and are resilient to disturbances. Very high risk mountain goat populations suggest that major declines are likely, local extirpation could occur, and the population may have very low resilience to disturbance.

Table A3: Risk categories for mountain goat indicators

Percent deviation from current conditions	0-20%	20-40%	40-60%	60-80%	80-100%
Risk class	very low	low	moderate	high	very high

Grizzly Bear

To assess the magnitude of risk to grizzly bear populations, five risk categories were used but with a different scale compared to the other three environmental values (see Table A4 below). Based on this scale of risk, four of five grizzly bear indicators were evaluated (mortality risk was analyzed subjectively and no risk scale was used).

First, risk to critical habitat was assessed by comparing the amount of overlap between critical habitat and the THLB, and the amount of THBL that is critical habitat. In both cases a percent area was calculated and was directly translated into a risk category. For example, if there was a 25% overlap between critical habitat and the THLB in a LU, this translates into a moderate risk to critical habitat.

Second, risk to landscape-level forage supply was assessed by simulating the number of bears the habitat could support based on changes in seral stage distribution. The deviation from the current number of simulated bears provides the measure of risk. A 5% decline in bears translates into very low risk to landscape-level forage supply over the planning time frame.

Third, road displacement risk was assessed by examining changes in habitat effectiveness, and the number of bears that could be supported. An estimated 14% decline in bear numbers indicates low risk to bear habitat effectiveness as a result of road displacement.

Fourth, similar to road displacement, displacement risk due to recreation and tourism was also assessed by examining changes in habitat effectiveness, and the number of bears that can be supported; it was also evaluated in the same way as road displacement.

Table A4: Risk categories for grizzly bear indicators

Percent deviation from current conditions	0-10%	10-20%	20-30%	30-40%	>40%
Risk class	very low	low	moderate	high	very high

APPENDIX II - REPRESENTATION BY ECOSYSTEMS (AU X BEC) ACROSS THE FOUR SCENARIOS.

The following table shows which ecosystems are evenly, under-represented or over-represented in protection areas by scenario, and should be used to augment the general patterns shown in Table 3.3. The last three columns show the additional ecosystem representation gained across the four scenarios. SBC = spatial base case (Baseline Scenario), Low (LRMP 1 Scenario), Med (LRMP 2 Scenario), and High (LRMP 3 Scenario) protection areas are the three scenarios. Note that some ecosystems have very low total area (3rd column).

Table A5: Representation by Ecosystems

AU	BEC	Total Area of Ecosystem (ha) All Ages	SBC Total in PA (ha)	SBC Percent in PA (%)	Low PA Total Area in PA (ha)	Low PA Percent in PA (%)	Med PA Total Area in PATotal (ha)	Med PA Percent in PA (%)	High PA Total Area in PA (ha)	High Percent in PA (%)	Difference Low minus SBC	Difference Med minus SBC	Difference High minus SBC
CedarHigh	CWHvh2	947	9	1.0	14	1.5	14	1.5	51	5.4	0.5	0.5	4.5
	CWHvm	717	7	1.0	36	5.0	51	7.2	109	15.2	4.1	6.2	14.3
	CWHwm	49		0.0	3	6.8	3	6.8	10	21.1	6.8	6.8	21.1
	MHmm1	26		0.0		0.0	6	23.1	6	23.1	0.0	23.1	23.1
	MHwh1	11		0.0		0.0		0.0	1	9.1	0.0	0.0	9.1
CedarHigh Total		1,754	16	0.9	54	3.1	75	4.3	178	10.1	2.1	3.3	9.2
CedarLow	CWHvh2	576,928	5,706	1.0	37,636	6.5	108,924	18.9	182,047	31.6	5.5	17.9	30.6
	CWHvm	102,811	2,392	2.3	12,105	11.8	37,891	36.9	53,201	51.7	9.4	34.5	49.4
	CWHwm	41,366		0.0	4,744	11.5	6,005	14.5	9,023	21.8	11.5	14.5	21.8
	CWHws2	1,429		0.0		0.0	22	1.5	1,180	82.6	0.0	1.5	82.6
	MHmm1	31,551	1,061	3.4	4,122	13.1	9,853	31.2	16,281	51.6	9.7	27.9	48.2
	MHmm2	730		0.0		0.0	21	2.9	730	100.0	0.0	2.9	100.0
	MHwh1	46,933	426	0.9	2,023	4.3	4,252	9.1	12,223	26.0	3.4	8.2	25.1
CedarLow Total		802,013	9,585	1.2	60,630	7.6	166,968	20.8	274,806	34.3	6.4	19.6	33.1
CedarMed	CWHvh2	16,059	225	1.4	411	2.6	910	5.7	2,078	12.9	1.2	4.3	11.5
	CWHvm	8,085	155	1.9	371	4.6	971	12.0	1,358	16.8	2.7	10.1	14.9
	CWHwm	2,141		0.0	142	6.6	253	11.8	508	23.7	6.6	11.8	23.7
	CWHws2	122		0.0		0.0		0.0	80	65.5	0.0	0.0	65.5
	MHmm1	309		0.0		0.0	52	16.8	77	24.9	0.0	16.8	24.9

AU	BEC	Total Area of Ecosystem (ha) All Ages	SBC Total in PA (ha)	SBC Percent in PA (%)	Low PA Total Area in PA (ha)	Low PA Percent in PA (%)	Med PA Total Area in PATotal (ha)	Med PA Percent in PA (%)	High PA Total Area in PA (ha)	High Percent in PA (%)	Difference Low minus SBC	Difference Med minus SBC	Difference High minus SBC
	MHwh1	721		0.0	34	4.7	38	5.3	113	15.7	4.7	5.3	15.7
CedarMed Total		27,485	380	1.4	958	3.5	2,225	8.1	4,258	15.5	2.1	6.7	14.1
Cottonwood	CWHvm	723	35	4.8	35	4.8	47	6.5	85	11.7	0.0	1.7	6.9
	CWHwm	362		0.0	55	15.2	357	98.6	357	98.6	15.2	98.6	98.6
	CWHws1	609		0.0		0.0		0.0	323	53.1	0.0	0.0	53.1
Cottonwood Total		1,708	45	2.6	100	5.9	414	24.2	779	45.6	3.2	21.6	43.0
HemBalHigh	CWHvh2	1,331		0.0	12	0.9	16	1.2	145	10.9	0.9	1.2	10.9
	CWHvm	5,151	102	2.0	127	2.5	556	10.8	921	17.9	0.5	8.8	15.9
	CWHwm	1,098		0.0	176	16.0	196	17.9	242	22.0	16.0	17.9	22.0
	CWHws1	780		0.0		0.0	1	0.1	417	53.5	0.0	0.1	53.5
	CWHws2	418		0.0		0.0		0.0	105	25.1	0.0	0.0	25.1
	MHmm1	125		0.0	2	1.6	2	1.6	20	16.0	1.6	1.6	16.0
	MHwh1	98		0.0		0.0		0.0	12	12.2	0.0	0.0	12.2
HemBalHigh Total		9,049	102	1.1	317	3.5	772	8.5	1,881	20.8	2.4	7.4	19.7
HemBalLow	CWHvh2	40,041	192	0.5	2,626	6.6	4,057	10.1	8,318	20.8	6.1	9.7	20.3
	CWHvm	77,417	5,823	7.5	7,689	9.9	31,464	40.6	44,822	57.9	2.4	33.1	50.4
	CWHwm	36,675		0.0	4,369	11.9	10,591	28.9	14,684	40.0	11.9	28.9	40.0
	CWHws1	3,435		0.0		0.0	56	1.6	1,730	50.4	0.0	1.6	50.4
	CWHws2	9,352		0.0		0.0	31	0.3	5,628	60.2	0.0	0.3	60.2
	MHmm1	52,188	2,947	5.6	6,673	12.8	17,460	33.5	33,475	64.1	7.1	27.8	58.5
	MHmm2	14,715		0.0		0.0	1,730	11.8	13,588	92.3	0.0	11.8	92.3
	MHwh1	16,691	89	0.5	899	5.4	1,611	9.7	4,485	26.9	4.9	9.1	26.3
HemBalLow Total		250,527	9,051	3.6	22,257	8.9	67,000	26.7	126,730	50.6	5.3	23.1	47.0
HemBalMed	CWHvh2	14,743	137	0.9	347	2.4	462	3.1	1,570	10.7	1.4	2.2	9.7
	CWHvm	24,600	1,622	6.6	2,050	8.3	4,804	19.5	6,611	26.9	1.7	12.9	20.3
	CWHwm	6,471		0.0	977	15.1	1,739	26.9	2,223	34.4	15.1	26.9	34.4
	CWHws1	2,692		0.0		0.0		0.0	830	30.8	0.0	0.0	30.8
	CWHws2	1,911		0.0		0.0		0.0	560	29.3	0.0	0.0	29.3
	MHmm1	1,277	24	1.9	44	3.5	213	16.6	351	27.5	1.6	14.8	25.6
	MHmm2	302		0.0		0.0		0.0	155	51.3	0.0	0.0	51.3
	MHwh1	847		0.0	10	1.2	19	2.3	82	9.6	1.2	2.3	9.6
HemBalMed Total		52,843	1,783	3.4	3,429	6.5	7,237	13.7	12,383	23.4	3.1	10.3	20.1

AU	BEC	Total Area of Ecosystem (ha) All Ages	SBC Total in PA (ha)	SBC Percent in PA (%)	Low PA Total Area in PA (ha)	Low PA Percent in PA (%)	Med PA Total Area in PATotal (ha)	Med PA Percent in PA (%)	High PA Total Area in PA (ha)	High Percent in PA (%)	Difference Low minus SBC	Difference Med minus SBC	Difference High minus SBC
OtherDecid	CWHvh2	2,223	10	0.4	91	4.1	123	5.5	332	14.9	3.6	5.1	14.5
	CWHvm	3,393	198	5.8	210	6.2	1,108	32.7	1,490	43.9	0.4	26.8	38.1
	CWHwm	783		0.0	93	11.9	139	17.8	177	22.6	11.9	17.8	22.6
	CWHws1	356		0.0		0.0	21	5.9	168	47.2	0.0	5.9	47.2
OtherDecid Total		6,819	208	3.1	394	5.8	1,391	20.4	2,178	31.9	2.7	17.3	28.9
Pine	CWHvh2	61,713	144	0.2	20,745	33.6	29,044	47.1	35,120	56.9	33.4	46.8	56.7
	CWHwm	288		0.0		0.0		0.0		0.0	0.0	0.0	0.0
	CWHws1	315		0.0		0.0		0.0		0.0	0.0	0.0	0.0
	MHwh1	1,244		0.0	421	33.8	428	34.4	428	34.4	33.8	34.4	34.4
Pine Total		63,656	144	0.2	21,166	33.3	29,491	46.3	35,595	55.9	33.0	46.1	55.7
SpruceHigh	CWHvh2	691		0.0	21	3.0	52	7.5	92	13.3	3.0	7.5	13.3
	CWHvm	2,836	513	18.1	522	18.4	1,039	36.7	1,498	52.8	0.3	18.6	34.7
	CWHwm	606		0.0	106	17.6	121	20.0	131	21.6	17.6	20.0	21.6
	CWHws1	43		0.0		0.0		0.0	9	20.5	0.0	0.0	20.5
SpruceHigh Total		4,207	515	12.2	651	15.5	1,215	28.9	1,746	41.5	3.2	16.6	29.3
SpruceLow	CWHvh2	3,694	93	2.5	317	8.6	546	14.8	838	22.7	6.1	12.3	20.2
	CWHvm	3,866	430	11.1	480	12.4	1,833	47.4	2,438	63.1	1.3	36.3	51.9
	CWHwm	1,108		0.0	153	13.8	273	24.7	292	26.4	13.8	24.7	26.4
	CWHws1	200		0.0		0.0	6	3.0	9	4.5	0.0	3.0	4.5
	CWHws2	94		0.0		0.0		0.0	19	20.2	0.0	0.0	20.2
	MHmm1	332	57	17.2	79	23.8	132	39.8	183	55.1	6.6	22.6	38.0
	MHwh1	335		0.0	1	0.3	1	0.3	31	9.3	0.3	0.3	9.3
SpruceLow Total		9,629	580	6.0	1,030	10.7	2,791	29.0	3,810	39.6	4.7	23.0	33.5
SpruceMed	CWHvh2	2,252		0.0	22	1.0	62	2.8	236	10.5	1.0	2.8	10.5
	CWHvm	4,967	592	11.9	635	12.8	1,782	35.9	2,399	48.3	0.9	24.0	36.4
	CWHwm	683		0.0	79	11.6	258	37.8	270	39.6	11.6	37.8	39.6
	CWHws1	295		0.0		0.0	2	0.7	16	5.3	0.0	0.7	5.3
SpruceMed Total		8,386	594	7.1	739	8.8	2,106	25.1	2,938	35.0	1.7	18.0	27.9
Grand Total		1,238,076	23,003	1.9	111,724	9.0	281,685	22.8	467,282	37.7	7.2	20.9	35.9